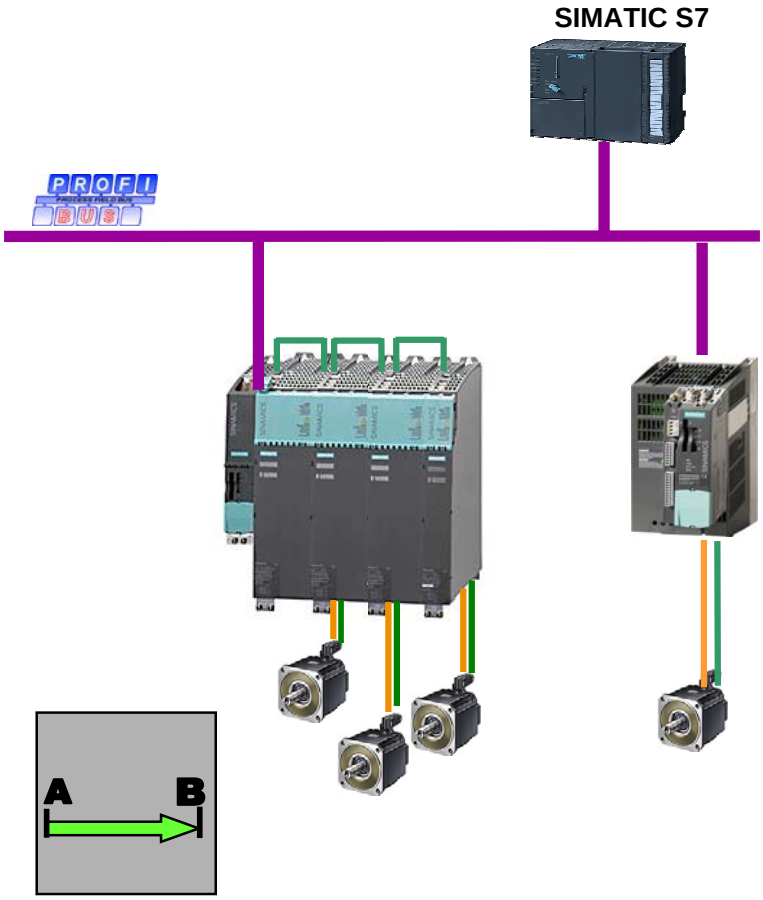
SINAMICS S120 Epos bus connection



applications & TOOLS

Connecting a SINAMICS S120 with Basic Positioner function module to PROFIBUS

SIEMENS

Application No.: AXXXXXXX-N00XXX-A0XXX

We reserve the right to make technical changes to the product.

Copyright

General information

Note

The standard applications are not binding and do not claim to be complete regarding the circuits shown and equipping as well as possible eventualities. The standard applications do not represent customer-specific solutions. They are only intended to provide support for typical applications. You are responsible in ensuring that the described products are correctly used. These standard applications do not relieve you of the responsibility of safely and professionally using, installing, operating and servicing equipment. When using these standard applications, you recognize that Siemens cannot be made liable for any damage/claims beyond the liability clause describe. We reserve the right to make changes to these standard applications at any time without prior notice. If there are any deviations between the recommendations provided in these standard applications and other Siemens publications - e.g. Catalogs, then the contents of the other documents have priority.

Warranty, liability and support

We do not accept any liability for the information contained in this document.

Claims against us - irrespective of the legal grounds - resulting from the use of the examples, information, programs, engineering and performance data etc., described in this standard application are excluded. Such an exclusion shall not apply where liability is mandatory e.g. under the German Product Liability Act involving intent, gross negligence, or injury of life, body or health, guarantee for the quality of a product, fraudulent concealment of a deficiency or non-performance. Claims of the purchaser for compensation relating to non-performance of essential contract obligations shall be limited to foreseeable damages typically covered by a contract unless intent, willful misconduct or gross negligence is involved or injury of life, body or health. The above stipulations shall not change the burden of proof to your detriment.

If you have any questions relating to this document then please send them to us at the following e-mail address:

mailto:applications.erlf@siemens.com

Valid conditions

/ Alternative 1: (internal business)
If nothing else has been negotiated, then the "Conditions for the supply and services in Siemens internal business" applies in the version that is valid at the time that the equipment is purchased.

/ Alternative 2: (domestic business of Siemens AG)
If nothing else has been negotiated, then the "General License Conditions for Software for Automation and Drives for Customers with a Seat or Registered Office in Germany", valid at the time of sale, are applicable.

/ Alternative 3: (direct export business of Siemens AG)
If nothing else has been negotiated, then the "General License Conditions for Software Products for Automation and Drives for Customers with a Seat or Registered Office outside Germany", valid at the time of sale, are applicable.

/ Alternative 4: (conditions of the particular regional office for the regional office business)
If nothing else has been negotiated, then the "...", valid at the time of sale, are applicable.

Qualified personnel

In the sense of this documentation qualified personnel are those who are knowledgeable and qualified to mount/install, commission, operate and service/maintain the products which are being used. He or she must have the appropriate qualifications to carry-out these activities
e.g.:

Trained and authorized to energize and de-energize, ground and tag circuits and equipment according to applicable safety standards.

Trained or instructed according to the latest safety standards in the care and use of the appropriate safety equipment.

Trained in rendering first aid.

There is no explicit warning information in this documentation. However, reference is made to warning information and instructions in the Operating Instructions for the particular product.

Reference regarding export codes

AL: N

ECCN: N

Foreword

Objective of the application

Generally, electric drives are controlled from a higher-level control system. Traversing commands are entered and feedback signals are evaluated.

This application shows how a SINAMICS S120 drive with the basic positioner function module (in the following text abbreviated with Epos) can be very simply connected to a SIMATIC S7. In this case, the interface from the perspective of the control is described just the same as the perspective from the drive. Numerous different applications can be implemented using simple communication mechanisms.

Core contents of this application

The following core issues are discussed in this application:

Connecting the bus to a SIMATIC S7 control

Controlling the drive using a variable table

Addressing all operating modes and evaluating the feedback signals

Scope of the document

Neither the automatic configuration nor the OFFLINE data set. configuration is described as long as they do not involve Epos.

The optimization procedures for the current / speed and position controller are also not described.

List of contents

Description of the function module basic positioner

Contents

Here you can get an overview of the functionality of the function module basic positioner (Epos). You will get to know the components that are used (standard hardware and software components as well as the user interface specifically generated for the purpose).

1 Basic information

1.1 Target group

The standard application is intended for all programming engineers and users that wish to simply and quickly implement a Profibus connection using the SINAMCIS S120 with activated basic positioner function module (abbreviated - Epos) and a SIMATIC S7. Standard telegrams also exist for this purpose. However, the aim of this application is to cover the complete functionality of Epos whereby the interface should remain as basic as possible (low overhead).

A standard structure has been defined for sending data to the drive as well as also receiving data from the drive. This is reflected in two S7 UDTs (one for sending and one for receiving data) as well as also the binector/connector links in the drive.

1.2 Technical environment

This standard application can be used, unchanged in conjunction with a SIMATIC S7 315-2AF03-0AB0 and a SINAMICS S120 single-axis demonstration case.

An HMI project is optionally available. This can be used to set control signals via an operator interface and evaluate the feedback signals. This is also helpful in quickly getting to know the individual functions and operating modes.

1.3 Components included in the standard application

Operator panel (this can be optionally used)

This is displayed using the ProTool – Runtime or WinCC flexible Runtime software directly at the engineering PC. All of the signals involved are linked as variables in the HMI project.

SIMATIC S7

Receive and send data blocks with an appropriate structure in the form of user-defined data types (udts)

Communication function block

Calling the communication blocks between the SIMATIC S7 and the drive (S7←→ S120)

SINAMICS S120

User-defined list to connect to Profibus

1.4 Software prerequisites

Releases required as a minimum

Table 1-1: Software prerequisites

Component	Version
STEP 7	V5.4 +SP1
STARTER or SCOUT	V4.0
DRIVE ES BASIC	V5.4

2 Functionality of the basic positioner

2.1 Tasks that can be solved

The basic positioner (Epos) is an extremely comprehensive and high-performance function module for the closed-loop position controlled motion of a SINAMICS S120 electric drive.

It is used for the absolute and relative positioning of linear and rotary axes (modulo) with motor encoder (indirect measuring system) or machine-mounted encoder (direct measuring system).

It is available in the basic closed-loop control types - closed-loop servo control and closed-loop vector control - as function module that can be additively activated.

Further, the STARTER engineering tool includes user-friendly configuration, commissioning and diagnostic functions for Epos.

Using the control panel the functionality can be controlled for either commissioning or diagnostics from the PC. This is extremely helpful - especially when it comes to "getting to know" the individual operating modes or also to test the function without requiring control from a higher-level automation system.

When the basic positioner is activated then the position controller is also activated. This is automatically executed using the drive Wizards of STARTER. Further, the "internal interconnections" (BICO technology) are required - that are necessary between Epos and the position controller - are automatically established (e.g. setpoints from Epos for closed-loop control, axis cycle correction, etc.).

The closed-loop position control essentially comprises the following parts:

Position actual value conditioning includes lower-level measuring probe (digital input for proximity switch) evaluation and reference mark search.

Position controller (including limits, adaptation, pre-control calculation)

Monitoring functions (standstill, positioning and dynamic following error monitoring, cam signals)

Further, the following functions can be implemented using the basic positioner:

Mechanical system:

Backlash compensation

Modulo correction

Limits:

Velocity/acceleration/deceleration limits

Software limit switch (traversing range limiting using position setpoint evaluation)

Stop cams (traversing range limiting by evaluating a hardware limit switch)

Positioning/standstill (zero speed) monitoring:

Following error monitoring

Two cam switching signals

2.2 Features

Epos is based on the functionality of the basic positioner of SIMOVERT MASTERDRIVES MC as well as also the traversing blocks of SIMODRIVE 611U - the opportunity was also taken to carry-out some innovation. The positioning functionality for vector axes was also added as well as additional useful functions (limit switch, following error monitoring, cam functionality etc.).

The outstanding features include:

"Flying" and "continuous" mode/setpoint changes during traversing motion

- without having to absolutely use the handshake technique,
- including "easy-to-use" benefits / connection,
- including transitions that shorten the process shortening without the axis coming to a standstill (zero speed)

Can be simply connected to higher-level control systems - as also described in this application

Can be simply adapted to a particular application and configured

Traversing blocks can be simply configured and “fixed" traversing blocks implemented

Graphic configuring, commissioning and operator control screen forms (tool including control panel)

Independent of the vector / servo control techniques (and their limitations)

Well-proven experience in this area of applications is being innovatively continued

2.3 Operating modes

Epos has the four following operating modes (that can be toggled between when the axis is in the "quiescent" state [no traversing command]:

Jogging (closed-loop position controlled)

Reference point approach

Traversing blocks
(positioning, based on SIMODRIVE 611U)

MDI/direct setpoint input
(positioning, based on MASTERDRIVES MC Epos)

-

including secondary "flying referencing" in the operating modes "Jogging", "Traversing blocks" and "MDI/direct setpoint input".

The priority of the operating modes with respect to each other when simultaneously selected:
Jogging > Reference point approach > MDI > Traversing blocks

If an operating mode is active – and an attempt is made to select another one – then an alarm message is output.

2.3.1 Jogging

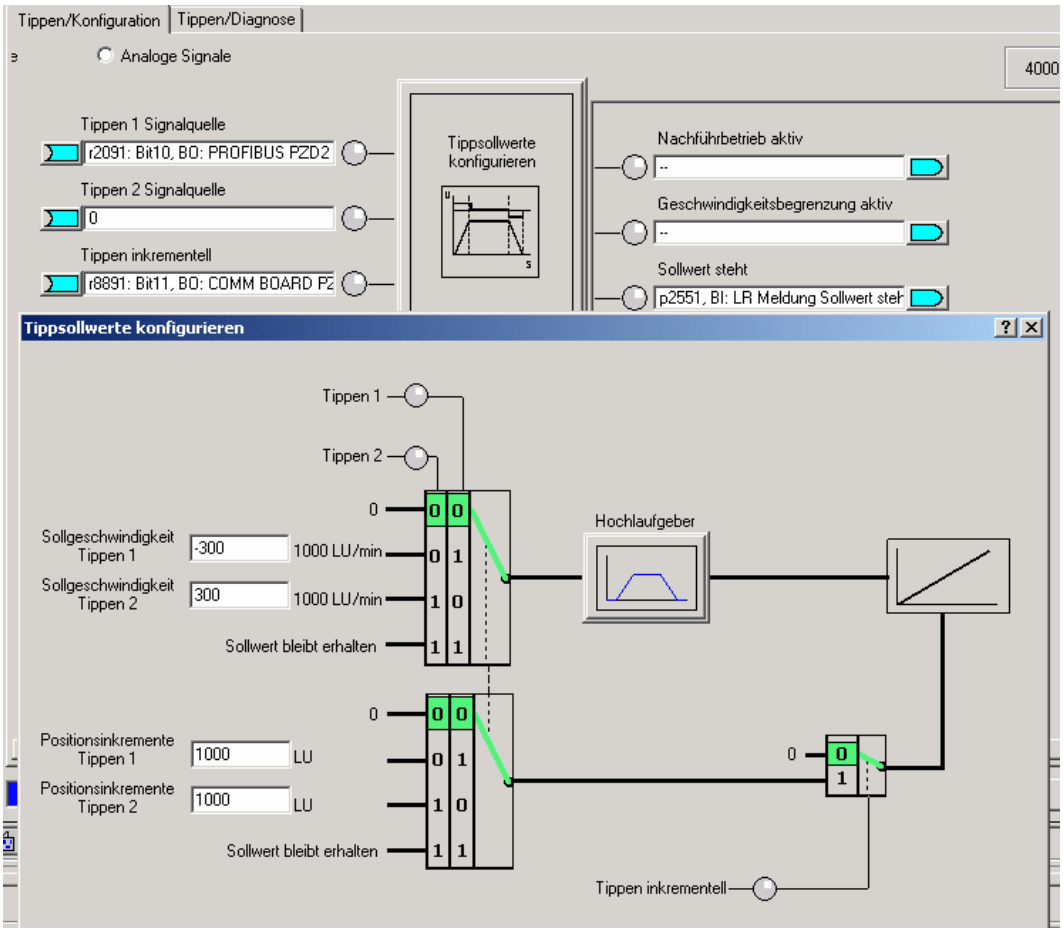
This involves moving the axis with closed-loop position control where it is possible to toggle between two modes

Mode: Endless, closed-loop position controlled by entering a v-set (the sign is evaluated)

Mode: Jogging, incremental (= to move through a specified "step")

Two selectable setpoints are available in both modes (jog 1 / 2)

Fig. 2-1: Configuring the jog setpoints



2.3.2 Homing [referencing]

This is also known as "active homing [referencing]".

Properties:

Fully automatic search and detection of the home [reference] position for incremental measuring systems (encoder).

The following referencing functions are supported:

"Cam and encoder zero mark", "encoder zero mark" "external equivalent zero mark (Bero)"

"Homing [referencing]" is also possible without the axis having to traverse. In this case, all of the operating modes must be de-selected.

Reverse cam functionality for the mode "Cam and encoder zero mark"

The homing [referencing] start direction can be entered

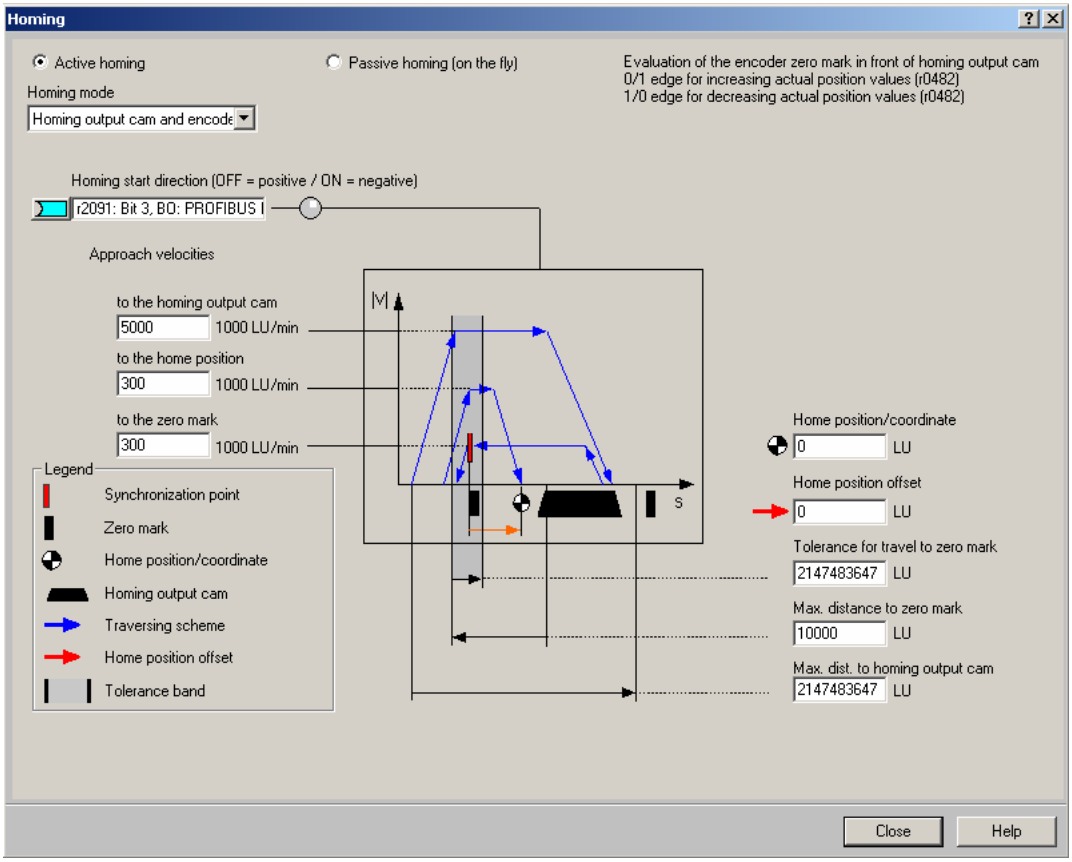
Various start velocities can be entered ("to the homing [referencing] output cam", "to the home [reference] position", "to the zero mark") - e.g. to increase the accuracy when detecting the home [reference] position

Monitoring using maximum traversing distances/tolerance bandwidths that can be entered, e.g. to cams, between cams and zero mark, distance to the zero mark

Automatic travel to the "home [reference] position offset" with respect to the home [reference] position and using home [reference] position coordinates that can be changed via BICO

Automatic direction of rotation reversal at the homing [referencing] output cam, therefore, for example: Reversal cams or hardware limit switches (when the STOP cam functionality is disabled) can be used as reference cam (this reduces hardware costs)
(in the specified START direction the zero mark is applicable as home [reference] position before the homing [referencing] output cam)

Fig. 2-2: Reference point approach



2.3.3 Flying homing [referencing] ("passive homing [referencing]")

This is also known as "passive homing [referencing]"

Features:

The axis is homed [referenced] during "normal" traversing motion using a "measuring probe" (digital input) for standard setting including possible continuous "post homing [referencing]"

Can be executed at a lower level in the "Jog", "Traversing blocks" and "MDI/direct setpoint input" modes

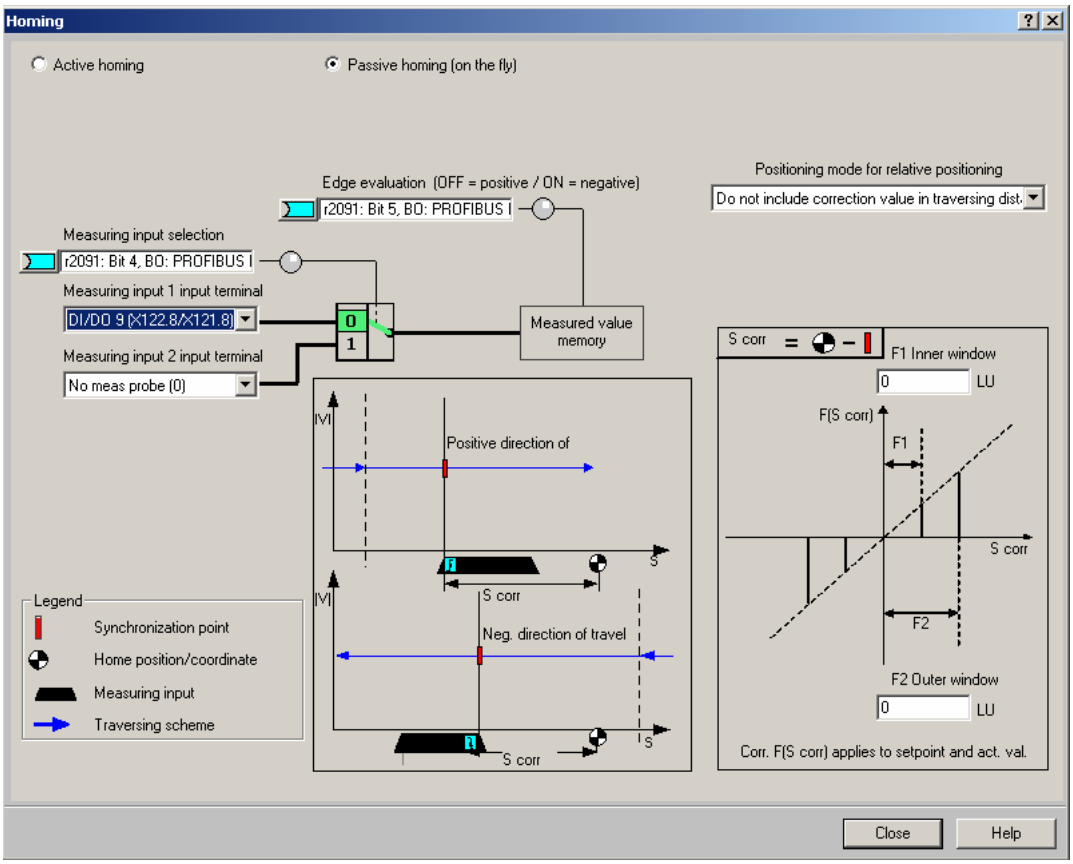
Can be selected for incremental and absolute measuring systems (encoder)

Measuring probe selection can be changed over (2 measuring probe inputs, can be selected with pos./neg. signal edges)

For "flying referencing", during RELATIVE positioning it can be selected as to whether the correction value for the traversing distance should be taken into account or not

For "post homing [referencing]" it is possible to evaluate a "real/incorrect" BERO signal (inner/outer position difference "window")

Fig. 2-3



2.3.4 Traversing blocks

This particular operating mode is based on the traversing blocks of SIMODRIVE 611U.

They support positioning using traversing blocks saved in the unit (for a homed [referenced] axis).

In this case 64 traversing blocks are possible - including advance conditions and specific tasks/requests.

Features:

User-friendly traversing block editor

For each block, e.g. position, velocity, acceleration as well as also deceleration override can be separately set.

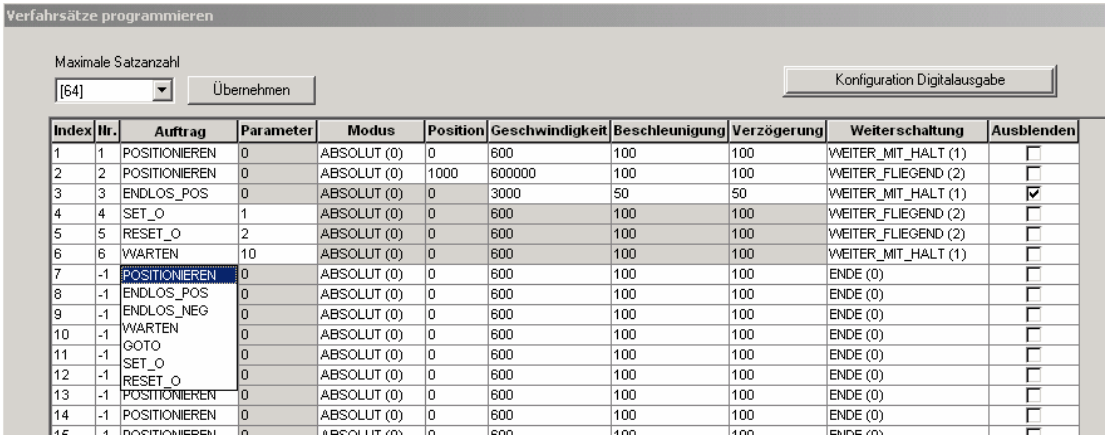
Jobs; e.g.:

- "Positioning, absolute / relative", "ABS_POS/_NEG" (forced direction of rotation input for modulo axes), "endless pos / neg", "wait" (delay time), "GOTO" (block step), "SET_O / RESET_O" (setting /resetting up to two digital outputs simultaneously)

It is possible to "hide" traversing blocks

By activating a new traversing block, a block being executed can be cancelled and a flying change made into the new traversing block.

Fig. 2-4: Traversing block editor



Index	Ilr.	Auftrag	Parameter	Modus	Position	Geschwindigkeit	Beschleunigung	Verzögerung	Weiterschaltung	Ausblenden
1	1	POSITIONIEREN	0	ABSOLUT (0)	0	600	100	100	WEITER_MIT_HALT (1)	☐
2	2	POSITIONIEREN	0	ABSOLUT (0)	1000	600000	100	100	WEITER_FLIEGEND (2)	☐
3	3	ENDLOS_POS	0	ABSOLUT (0)	0	3000	50	50	WEITER_MIT_HALT (1)	☑
4	4	SET_O	1	ABSOLUT (0)	0	600	100	100	WEITER_FLIEGEND (2)	☐
5	5	RESET_O	2	ABSOLUT (0)	0	600	100	100	WEITER_FLIEGEND (2)	☐
6	6	WARTEN	10	ABSOLUT (0)	0	600	100	100	WEITER_MIT_HALT (1)	☐
7	-1	POSITIONIEREN	0	ABSOLUT (0)	0	600	100	100	ENDE (0)	☐
8	-1	ENDLOS_POS	0	ABSOLUT (0)	0	600	100	100	ENDE (0)	☐
9	-1	ENDLOS_NEG	0	ABSOLUT (0)	0	600	100	100	ENDE (0)	☐
10	-1	WARTEN	0	ABSOLUT (0)	0	600	100	100	ENDE (0)	☐
11	-1	GOTO	0	ABSOLUT (0)	0	600	100	100	ENDE (0)	☐
12	-1	SET_O	0	ABSOLUT (0)	0	600	100	100	ENDE (0)	☐
13	-1	RESET_O	0	ABSOLUT (0)	0	600	100	100	ENDE (0)	☐
14	-1	POSITIONIEREN	0	ABSOLUT (0)	0	600	100	100	ENDE (0)	☐

The traversing blocks can also be changed for a drive that is operational. The next time that the traversing block is called, the changes are directly accepted.

2.3.5 MDI/direct setpoint input

Positioning based on "MASTERDRIVES MC" Epos functionality

Features:

Positioning/setting-up with direct setpoint inputs (e.g. process data of the PLC) - and it is continuously possible to influence the setpoints even during traversing motion.

"Flying and continuous" setpoint transfer during axis motion is possible, i.e. position, velocity setpoint and override, acceleration, deceleration, forced direction of rotation input can also be changed during operation.

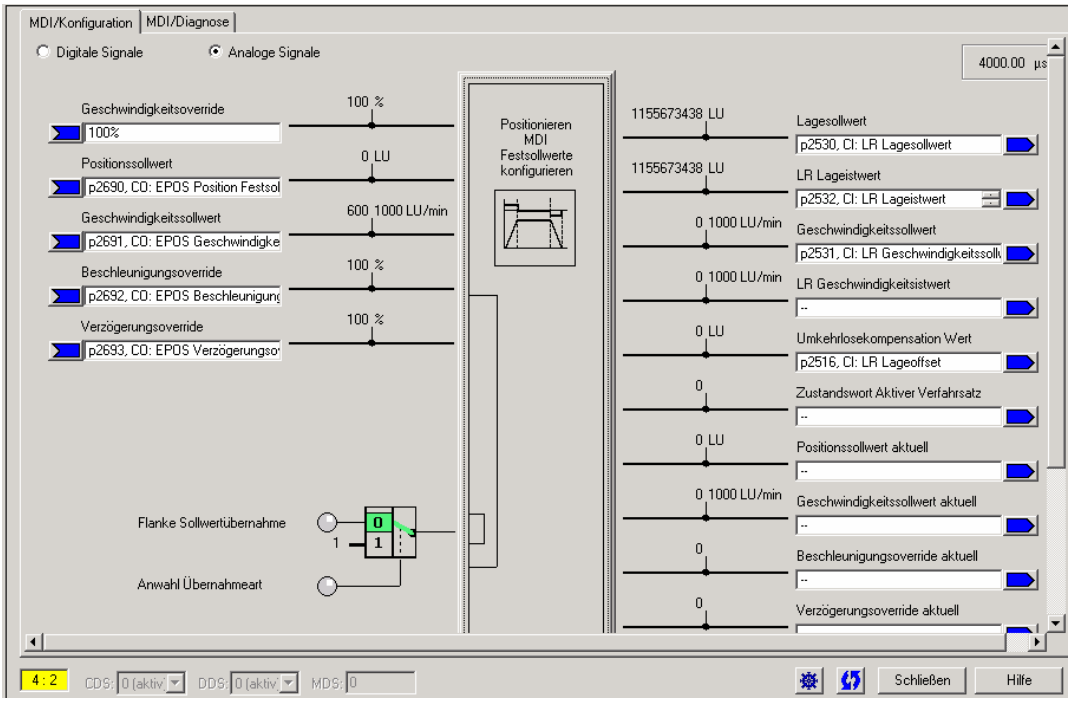
It is possible to make a "flying" change between the modes while the axis is moving:

Mode: Setting-up (endless, closed-loop position controlled, V-set input)

Mode: Positioning absolute / relative (for modulo, also: forced direction of rotation input or the shortest distance)

In MDI Mode it is possible using the setting-up mode or relative positioning mode to move an axis that has not been homed (referenced)

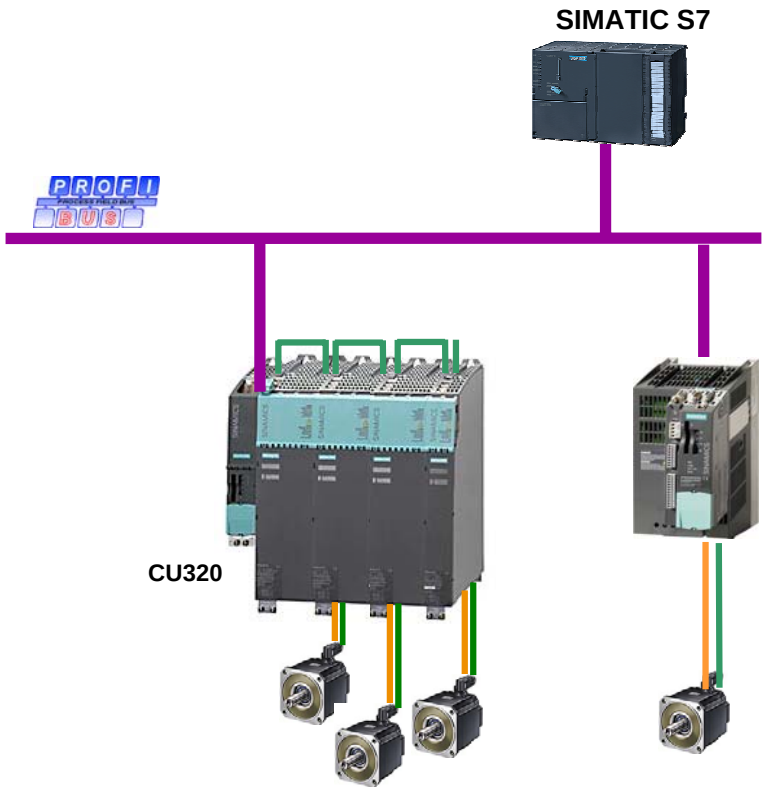
Fig. 2-5: MDI/configuration



3 Automation solution

A typical structure is subsequently shown where one CU320 controls three axes and one CU310 DP controls one axis. From the perspective of SIMATIC S7 this involves two Profibus slaves. in the hardware configuration of the SIMATIC Manager a differentiation is made between so-called drive objects (DOs) of the appropriate device connected to Profibus. A DO can be an axis - but also e.g. also the infeed module or terminal module etc.

Fig. 3-1: Example of a configuration



4 Program environment and interfaces

4.1 Overview control signals / setpoints

Those signals that are cyclically sent from the send data block to the drive are called control signals.

The user interface is shown in the following overview. You will find this structure both in the S7 block UDT101 as well as also in the user-defined value list for the drive that is supplied with this application.

A precise description of the function of the individual control and feedback signal bits is provided in the List Manual for SINAMICS S120 in Chapter 1, as well as in the Function Manual, Chapters 4.23 and 4.24.

The interface described in this application has the following structure:

Table 4-1: Process data

PZD	Assignment of the process data
PZD1	Application control word 1
PZD2	Application control word 2
PZD3	Application control word 3
PZD4	Velocity override for all operating modes (4000HEX = 100%)
PZD5	Position setpoint in [LU] for the direct setpoint input/MDI mode
PZD6	
PZD7	Acceleration override in the direct setpoint input/MDI mode
PZD8	Deceleration override for the direct setpoint input/MDI mode
PZD9	Reserve
PZD10	Reserve

Assignment of application control word 1

Table 4-2: Assignment of application control word 1

Bit	Abbr.	Designation (description of the HIGH signal level)	Drive parameter	Function chart
0	ON	ON command 0 = OFF1 active 1 = ON	P840	2501
1	CmdNo OFF2	Command, no OFF2 0 =: OFF2 active 1 = Signal: Operating condition - coast-down not active	P844	2501
2	CmdNo OFF3	Command, no OFF3 0 = OFF3 active 1 = Operating condition, fast stop not active	P848	2501
3	ENC	Enable controller – enable inverter	P852	2501
4	IntMStp	Traversing block and MDI – intermediate STOP Traversing blocks and MDI/direct setpoint input - intermediate stop 0 = Active traversing command is interrupted / axis brakes with the specified deceleration override 1 = No intermediate stop (the axis can be moved)	P2640	3616
5	RejTask	Traversing block and MDI - Reject Task Traversing blocks and direct setpoint input/MDI Reject traversing task 0 = Active traversing command is rejected / axis brakes down with 100% deceleration override 1 = Traversing task is not rejected (axis can be traversed)	P2641	3616
6				
7	AckFlt	Acknowledge fault	P2103	2501
8	Jog1	Jogging – signal source 1	P2589	3610
9	Jog2	Jogging – signal source 2	P2590	3610
10	LB	Life bit (PLC requests control)	P854	2501
11				
12	JogInc	Jogging – jogging incremental Jogging: 0 = Endless traversing 1 = Traversing through the parameterized distance	P2591	3610

Bit	Abbr.	Designation (description of the HIGH signal level)	Drive parameter	Function chart
13				
14	SftLimAct	Activates software limit switch	P2582	3630
15	StpCamAct	Activates the stop output cam	P2568	3630

Assignment of application control word 2

Table 4-3: Assignment of application control word 2

Bit	Abbr.	Designation	Drive parameter	Function chart
0	RefStart	Starts homing [referencing]	P2595	3612
1	RefPSet	Sets the home [reference] position Note: Functions for motors with absolute encoder - only for non-adjusted encoders!	P2596	3612
2	RefTyp	Homing [referencing] type 0 = Homing [referencing] 1 = Flying homing [referencing]	P2597	3612
3	RefStDi	Homing [referencing] start direction 0 = Positive start direction 1 = Negative start direction	P2604	3612
4	RefInpS	Homing [referencing] passive - input selection Sets the signal source to select the measuring probe for flying (passive) homing [referencing] 0 = Measuring probe 1 is activated 1 = Measuring probe 2 is activated	P2510	4010
5	RefEdge	Homing [referencing] passive - edge evaluation Passive homing [referencing]: Sets the edge evaluation 0 : Positive edge 1 : Negative edge	P2511	4010
6				
7				
8	MdiStart	Starts the direct setpoint input/MDI mode	P2647	3640
9	MdiSetup	Direct setpoint input/MDI – setup selection Selects MDI mode, setting-up 0 = Positioning 1 = Setting-up	P2653	3620
10	MdiPsTyp	Direct setpoint input/MDI – positioning type Positioning type 0 = Relative positioning 1 = Absolute positioning	P2648	3620

Bit	Abbr.	Designation	Drive parameter	Function chart
11	MdiPos	Direct setpoint input/MDI – positive direction Selects the direction for setting-up and absolute positioning of rotary axes in the positive direction	P2651	3620
12	MdiNeg	Direct setpoint input/MDI – negative direction Selects the direction for setting-up and absolute positioning of rotary axes in the negative direction	P2652	3620
13	MdiEdge	Direct setpoint input/MDI – transfer edge Edge, setpoint transfer if MdiTyp = 0	P2650	3620
14	MdiTrTyp	Direct setpoint input/MDI – transfer type Transfer type: 0 = Value transferred for a 0 → 1 edge at MdiEdge 1 signal : Continuous setpoint transfer	P2649	3620
15				

Assignment of application control word 3

Table 4-4: Assignment of application control word 3

Bit	Abbr.	Designation	Drive parameter	Function chart
0	TrvStart	Traversing block – activate traversing task (using 0→1 edge)	P2631	3640
1	TrvBit0	Traversing block – block selection bit 0	P2625	3640
2	TrvBit1	Traversing block – block selection bit 1	P2626	3640
3	TrvBit2	Traversing block – block selection bit 2	P2627	3640
4	TrvBit3	Traversing block – block selection bit 3	P2628	3640
5	TrvBit4	Traversing block – block selection bit 4	P2629	3640
6	TrvBit5	Traversing block – block selection bit 5	P2630	3640
7 .. 15		Reserve		

4.2 Overview of the feedback signals

Feedback signals are those signals that are cyclically transferred from the drive to the receive area of the data block. This structure of the receive area is also found in S7 block UDT102 and in the user-defined value list for the drive.

Table 4-5: Process data

PZD	Assignment of the process data
PZD1	Application status word 1
PZD2	Application status word 2
PZD3	Application status word 3
PZD4	Velocity actual value (this is referred to reference speed p2000)
PZD5	Note: 40000000HEX = 100%
PZD6	Position actual value [LU]
PZD7	
PZD8	Reserve
PZD9	Reserve
PZD10	Reserve

PZD 8, 9 and 10 can be used for additional display parameters - such as e.g.

Torque actual value r080 (100% = 4000 HEX referred to the reference torque p2003)

Temperature r035 (100°C = 4000HEX)

Actual fault number r2131

Actual alarm number r2132

Following error r2557

Etc.

Assignment of application status word 1

Table 4-6: Assignment of application status word

Bit	Abbr.	Designation	Drive parameter	Function chart
0	RTS	Ready to power up / to start	r899.0	2503
1	RDY	Ready to operate	r899.1	2503
2	IOP	In operation (operation enabled) Drive has been powered-up (condition to select the Epos operating mode)	r899.2	2503
3	Fault	Fault present	r2139.3	2548
4	NoOFF2Act	OFF2 inactive (sub condition for powering-up)	r899.4	2503
5	NoOFF3Act	OFF3 inactive (sub condition for powering-up)	r899.5	2503
6	PowInhbt	Power ON inhibit active	r899.6	2503
7	Alarm	Alarm present	r2139.7	2548
8	Stndstill	|n_act| < speed threshold value 3 [p2161] This bit is used to detect zero speed	r2199.0	2537
9	LB_CR	Lifebit control request - control requested	r899.9	2503
10	JogAct	Jogging active	r2094.0 [1)]	2460
11	RefAct	Homing [referencing] active	r2094.1 [1)]	2460
12	TrvBlAct	Traversing block active	r2094.2 [1)]	2460
13	MdiPosAct	MDI positioning active Positioning is active in the direct setpoint input/MDI mode	r2094.3 [1)]	2460
14	MdiStupAct	MDI setup active Setting-up is active in the direct setpoint input/MDI mode	r2094.4 [1)]	2460
15	FlyRefAct	Flying referencing active	r2684.1	3630

[1)] r2669 (function chart 3630) shown with a resolution down to one bit. For this purpose p2099[0] = r2699 is interconnected at the input of the connector-binector converter.

Assignment of application status word 2

Table 4-7: Assignment of application status word 2

Bit	Abbr.	Designation	Drive parameter	Function chart
0	ARFD	Reference point set	r2684.11	3612 3614
1	CmdAct	Traversing command active	r2684.15	3635
2	TargPos	Target position reached	r2684.10	4020
3	NoFlwErr	Following error in tolerance	r2684.8	4025
4	SftSwMinAct	Software limit switch minus active	r2683.6	3635
5	SftSwPlsAct	Software limit switch plus active	r2683.7	3635
6	StpCamMinAct	Stop cam minus active	r2684.13	3630
7	StpCamPlsAct	Stop cam plus active	r2684.14	3630
8	AckTrvBl	Acknowledge traversing block activated For traversing block or MDI/direct setpoint input mode for triggered setpoint transfer (MdiTrTyp = 0) the bit is used to acknowledge the traversing block.	r2684.12	3616
9	SetPStatic	Setpoint static (setpoint does not change)	r2683.2	3635
10	FWD	Axis forwards	r2683.4	3635
11	BWD	Axis backwards	r2683.5	3635
12	Accel	Axis accelerating	r2684.4	3635
13	Decel	Axis decelerating	r2684.5	3635
14	PrntMrkOut	Print mark outside outer window	r2684.3	3614
15	VelctyLimit	Velocity limiting active Velocity setpoint > p2572	r2683.1	3630

Assignment of application status word 3

Table 4-8: Assignment of application status word 3

Bit	Abbr.	Designation	Drive parameter	Function chart
0	AckTrvBit0	Active traversing block bit 0	r2670.0	3650
1	AckTrvBit1	Active traversing block bit 1	r2670.1	3650
2	AckTrvBit2	Active traversing block bit 2	r2670.2	3650
3	AckTrvBit3	Active traversing block bit 3	r2670.3	3650
4	AckTrvBit4	Active traversing block bit 4	r2670.4	3650
5	AckTrvBit5	Active traversing block bit 5	r2670.5	3650
6	TrvOut1	Direct output 1 via traversing block	r2683.10	3616
7	TrvOut2	Direct output 2 via traversing block	r2683.11	3616
8				
9				
10				
11				
12				
13	TrckMode	Tracking mode active	r2683.0	3635
14	PosSmCam1	Position actual value <= cam position 1	r2683.8	4025
15	PosSmCam2	Position actual value <=cam position 2	r2683.9	4025

5 Commissioning

5.1 Configuring the communications

The following configuring steps are required before commissioning PROFIBUS communications:

The DP interface is parameterized in the hardware configuration

Communications is adapted

Drives are parameterized

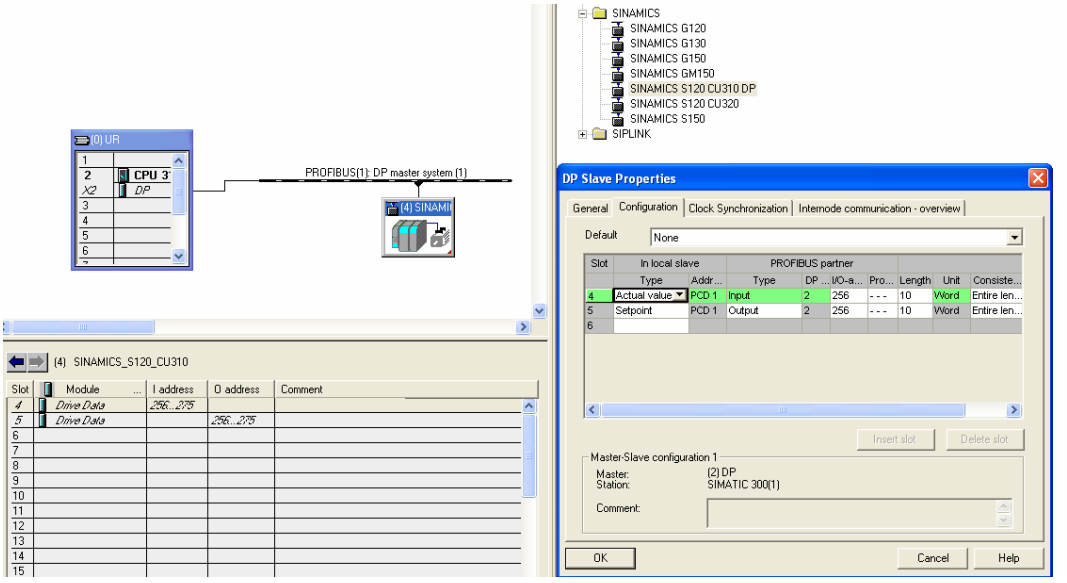
Parameterizing the DP interface in the SIMATIC Manager

The DP interface is parameterized in the hardware configuration of the SIMATIC Manager.

When a CPU with integrated DP interface or a DP communication processor is selected from the STEP 7 hardware catalog the hardware configuration is made available to a PROFIBUS-DP master system. After the master parameters have been set (e.g. baud rate) the SINAMICS from the hardware catalog must be assigned to the Profibus line. The Profibus address and the net data structure are now assigned.

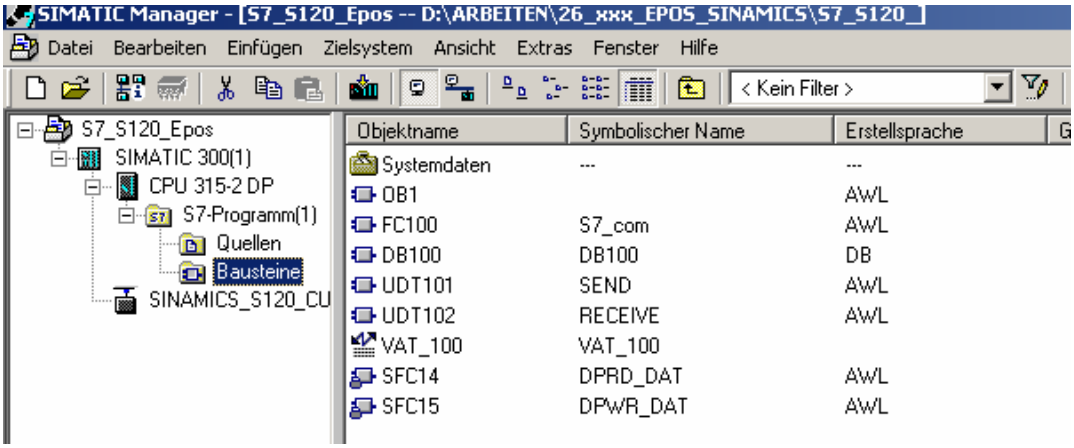
In this particular application, 10 words are used for sending and receiving per axis - which is freely defined:

Fig. 5-1: Parameterizing the DP interface



After the hardware has been configured the S7 blocks supplied are adapted. To start, copy the following block folder into your new project:

Fig. 5-2: Copying blocks



OB1 only calls FC100. Communications for one axis with I/O address 256 (=100HEX) is already set-up in FC100. The system functions SFC14 and SFC15 are called in FC100; these system functions are used to transfer data to and from the drive. The data are located in DB100. There is one send and receive area for each axis. The structure for sending (UDT101) and receiving (UDT102) is saved in the user-defined data types (UDT) (refer to Chapter "Program environment and interfaces").

If communications are to be established to additional drive objects (DOs) the following steps must be taken:

Appropriately extend the HW configuration (if axes are to be computed in the same Control Unit (CU) - axis separators and additional I/O areas must be inserted - or, for an additional CU, a new axis object must be set-up with its own Profibus address)

Align with the Profibus configuration for the drives

Extend DB100 and FC100 (including adapting the addresses)

Appropriately execute the axis configuration using Starter

Communication call in FC100:

Data is sent from DB100 to the drive or received from it using system functions SFC14 and SFC15.

Fig. 5-3: Communication call

```
FC100 : Title:
Network 1: Title:

      CALL  SFC   15
       LADDR  :=W#16#100
       RECORD :="DB100".SEND_AXIS_1
       RET_VAL:=#RET_VAL1


      CALL  SFC   14
       LADDR  :=W#16#100
       RET_VAL:=#RET_VAL2
       RECORD :="DB100".RECEIVE_AXIS_1
```

DB100 is also already set-up for one axis. The data block can be simply extended to handle several axes. To do this, one send area SEND (udt101) and receive area RECEIVE (udt102) are additionally set-up for each axis. In this case the FC100 must be appropriately extended.

Fig. 5-4: Extending the data block

Address	Name	Type	Initial val	Comment
0.0		STRUCT		
+0.0	SEND_AXIS_1	"SEND"		
+20.0	RECEIVE_AXIS_1	"RECEIVE"		
=40.0		END_STRUCT		

5.2 Configuring the drive

We recommend that a preliminary automatic configuration is first carried-out in order that the individual drive objects are correctly identified. The most important steps are again described below:

Go ONLINE and start the automatic configuration:

Fig. 5-5: Starting the automatic configuration

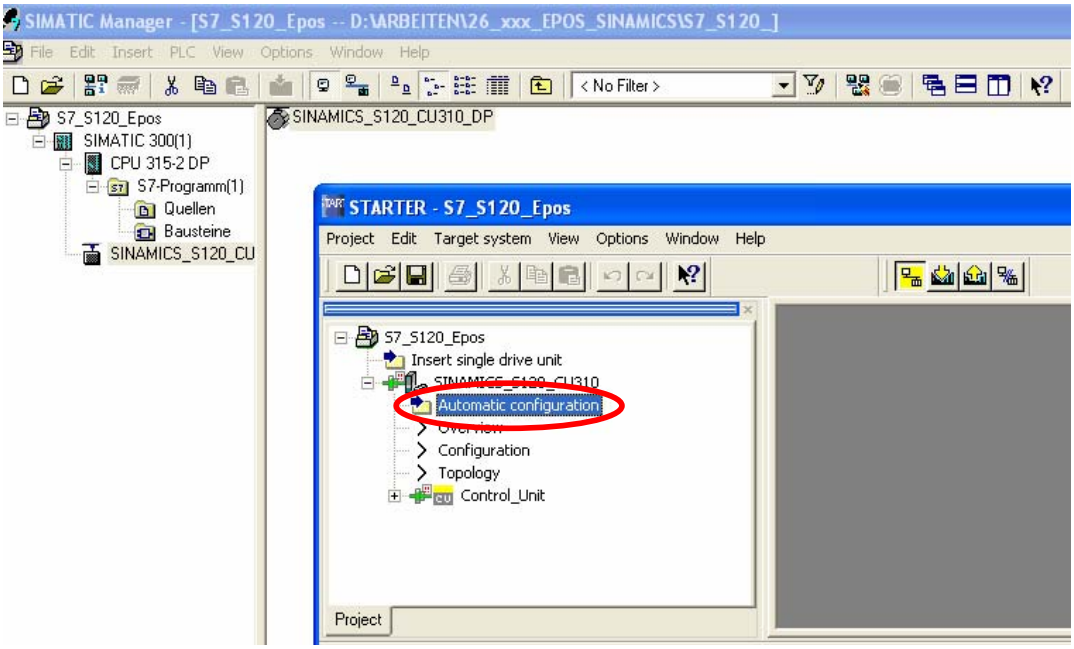
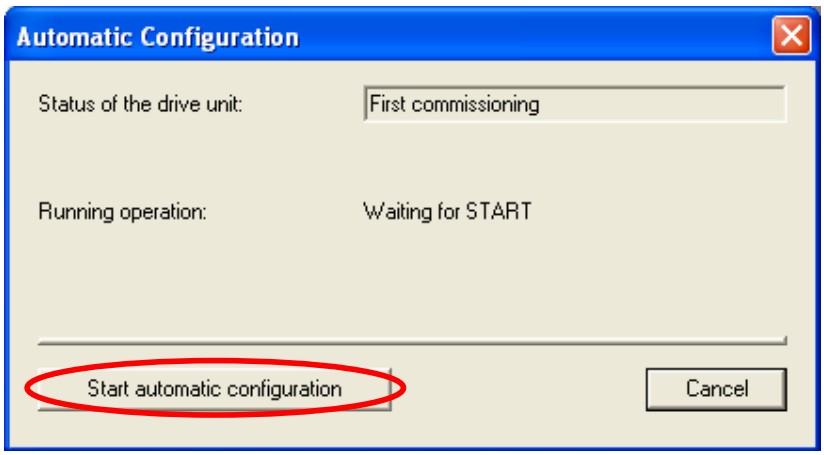
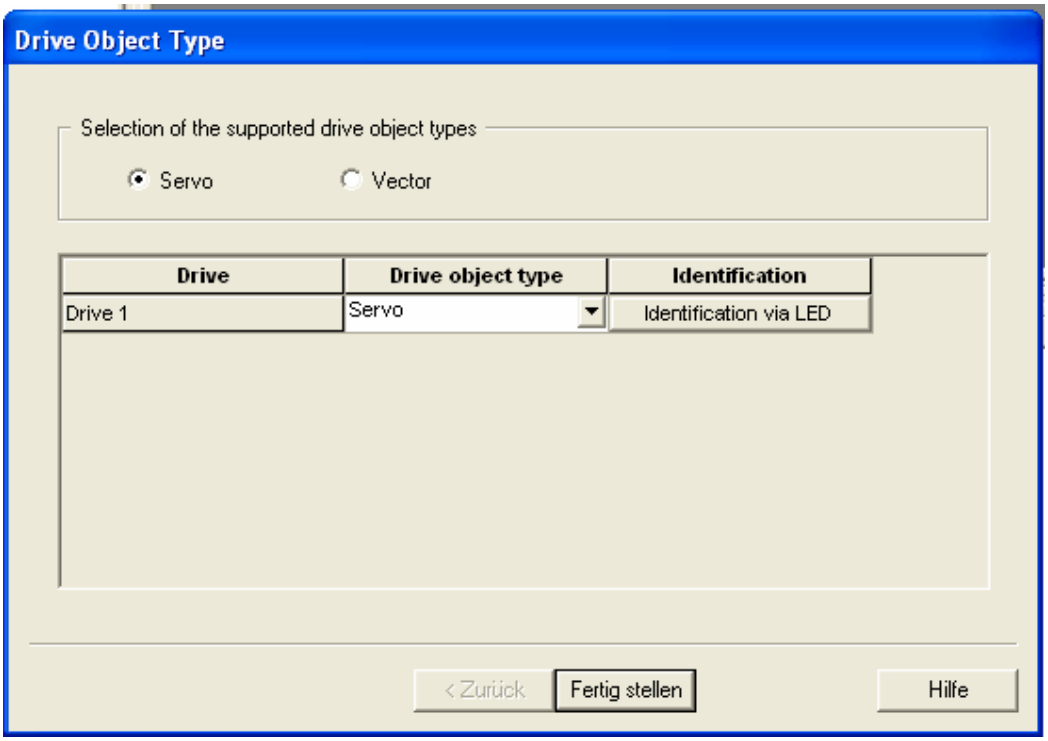


Fig. 5-6: Automatic configuration



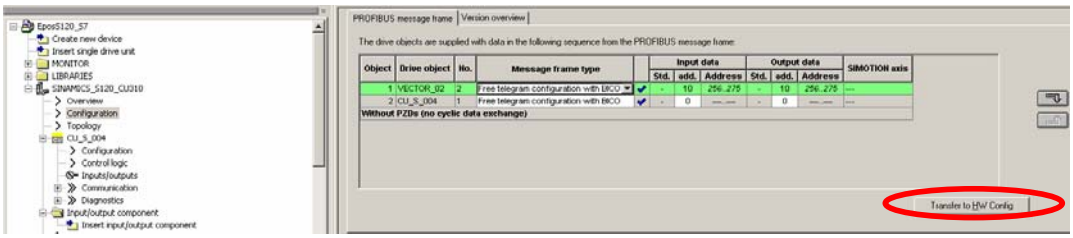
Select the required mode - either servo or vector:

Fig. 5-7: Selecting the required mode



After completing the configuration check the sequence with which the drive objects are supplied with data from the PROFIBUS telegram:

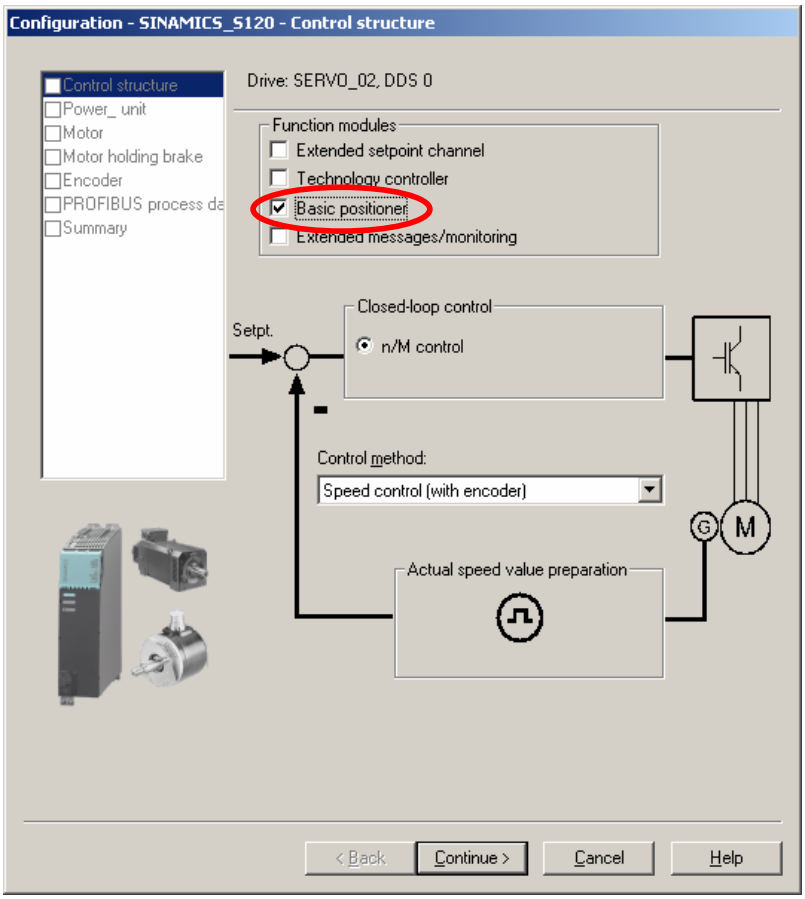
Fig. 5-8: Checking the sequence



If additional axes are set-up an alignment can be made by pressing the button "Transfer to HW Config". The HW configuration is then transferred.

Then configure the drive involved again OFFLINE. In so doing the basic positioner function module should be selected.

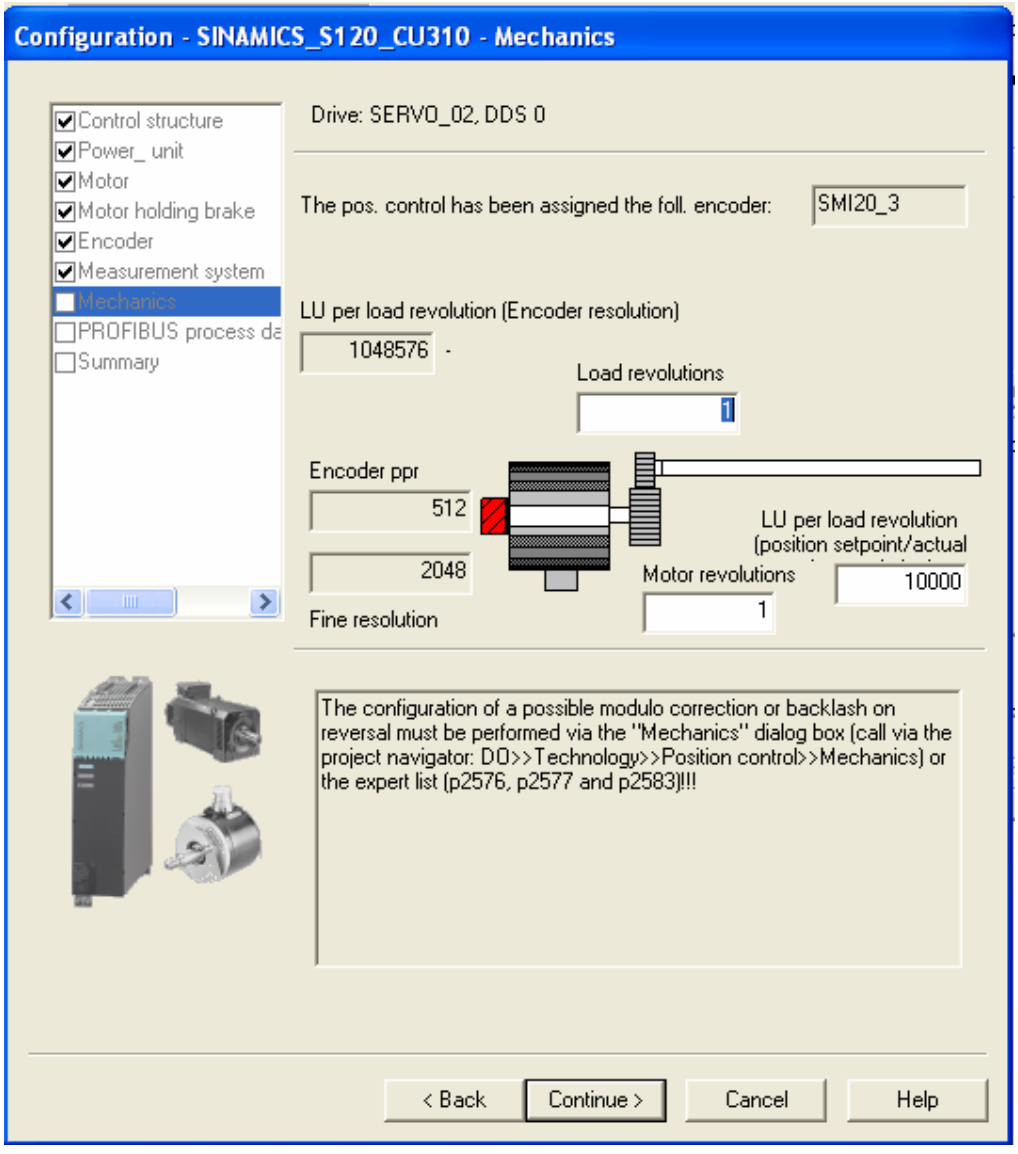
Fig. 5-9: Selecting the basic positioner



Note It would be possible to configure OFFLINE from the very start; however, this would mean that the advantage when using the automatically correct component identification would be lost.

The mechanical assignment should be parameterized in the additional screen forms. You can initially bypass this screen form.

Fig. 5-10: Parameterizing the mechanical assignment

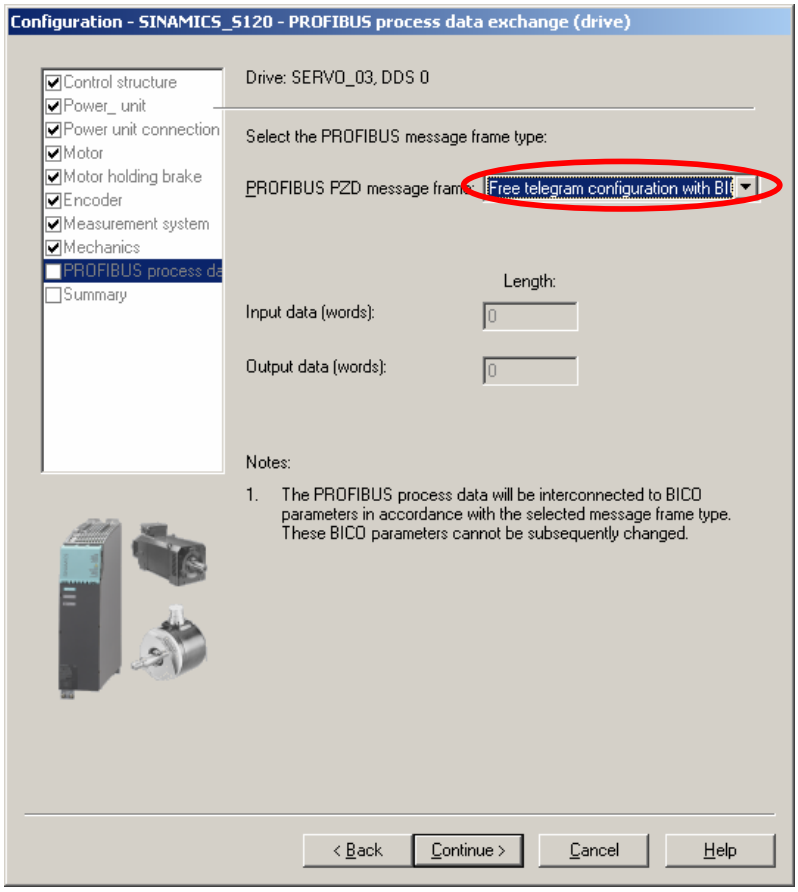


In the Profibus process data exchange screen do not select a standard telegram, but instead parameterize "**Free telegram configuration with Bico**".

Note

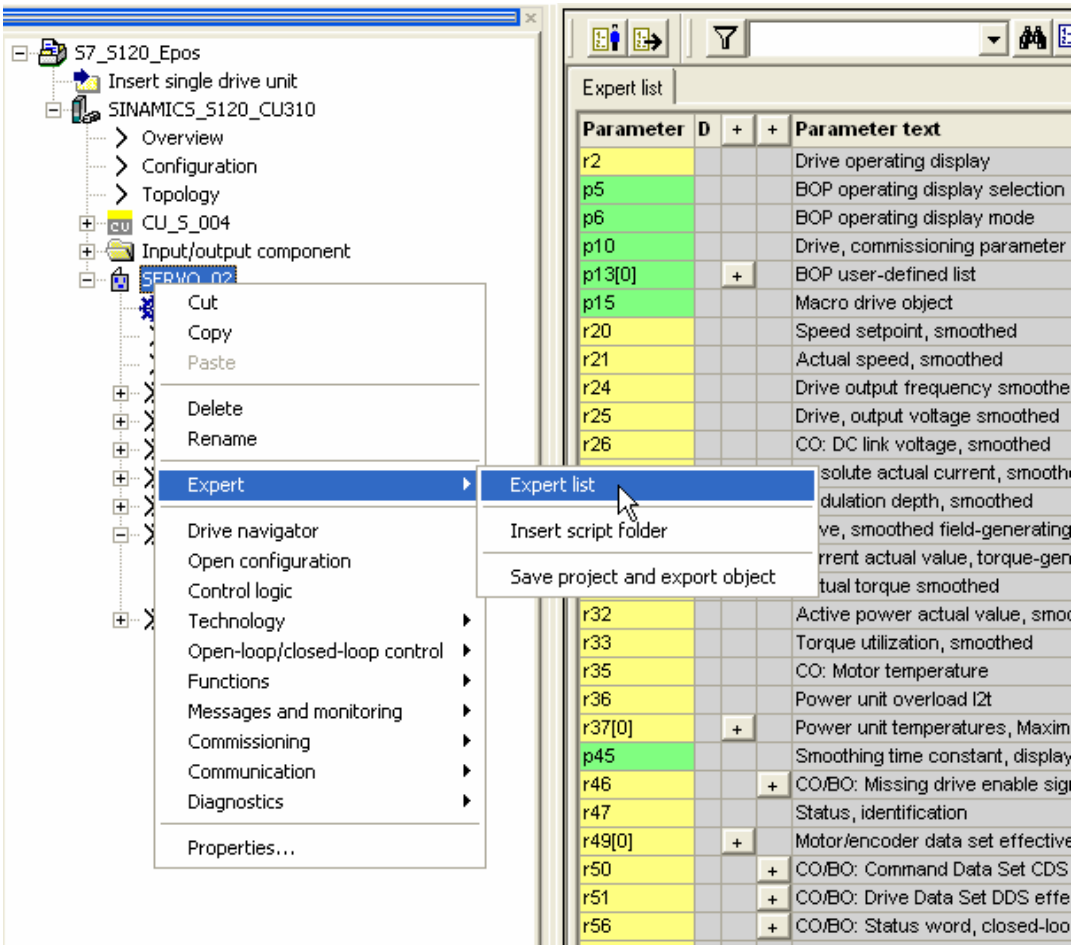
If a telegram is accidentally selected, then this telegram pre-assigns the parameters. When subsequently resetting the appropriate parameter p922 (telegram selection) in the drive object, the set parameters are not set back to the factory setting but remain as they are. This offers advantages if standard telegrams are to be extended.
User-defined lists can be provided on request. Using these user-defined lists, interconnections - pre-assigned by Profibus telegrams - can be undone.

Fig. 5-11: Selecting a telegram



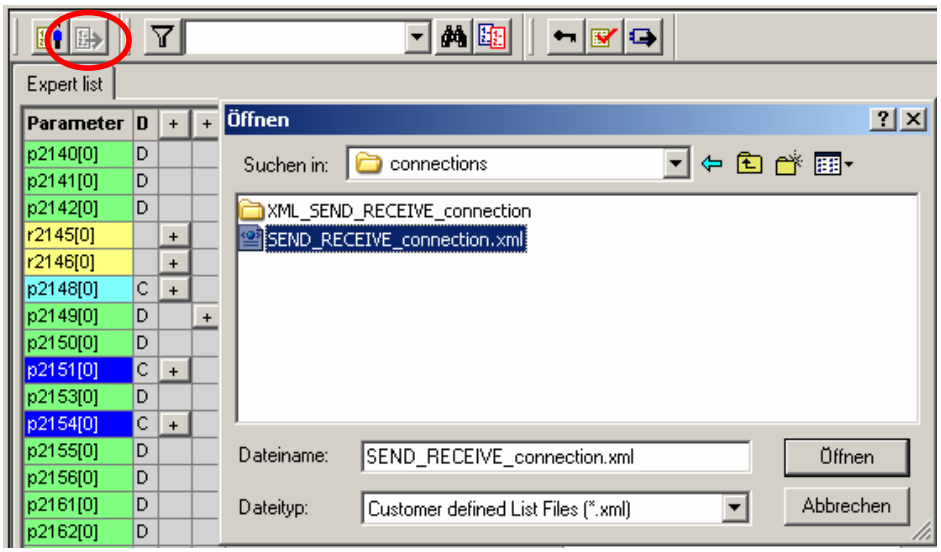
The Epos function module has now been activated. This means that the Profibus interconnection now have to be established in the send and receive directions. To do this the Expert list is opened:

Fig. 5-12: Opening the Expert list



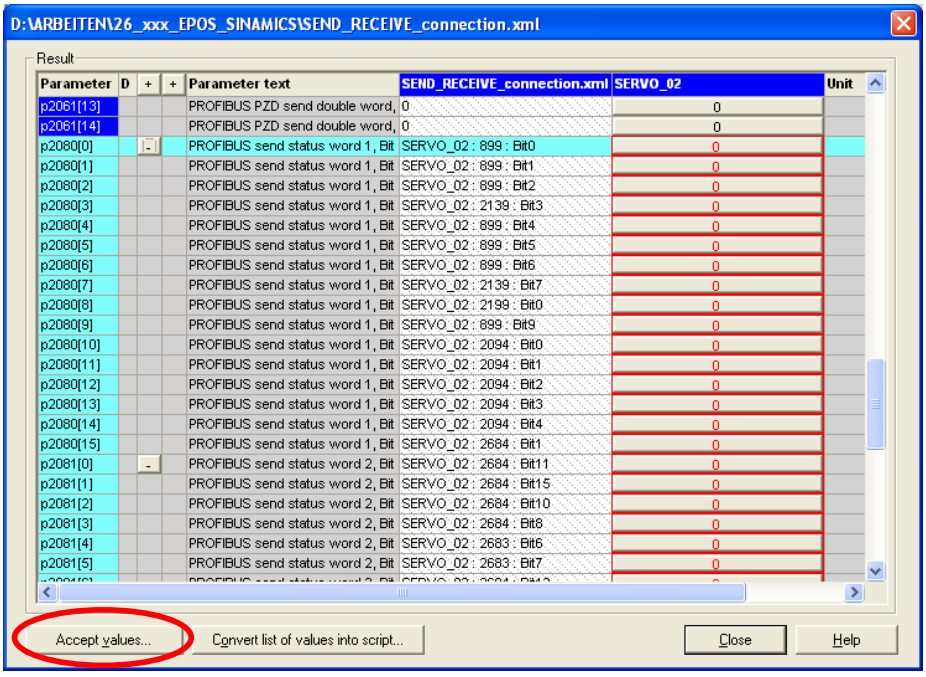
Now acknowledge the tab "Open user-defined value list" and search for the location where the supplied list is saved "SEND_RECEIVE_connection.xml":

Fig. 5-13: List supplied



The differences between the actual project (righthand column) and the user-defined list are now displayed in two columns:

Fig. 5-14: Display of the columns



Now accept the values.

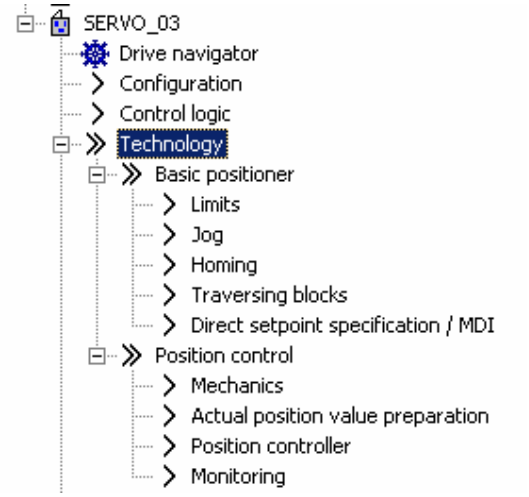
5.3 Application-specific settings

The appropriate signals are now interconnected in the drive. Now make additional applicable assignments - for example parameterizing the acceleration rates, velocities, positions, limit switches, following error monitoring functions, homing [referencing] position output cams etc.

To do this, work through the individual screens.

Optimize the control loop of your drive.

Table 5-1: Application-specific settings



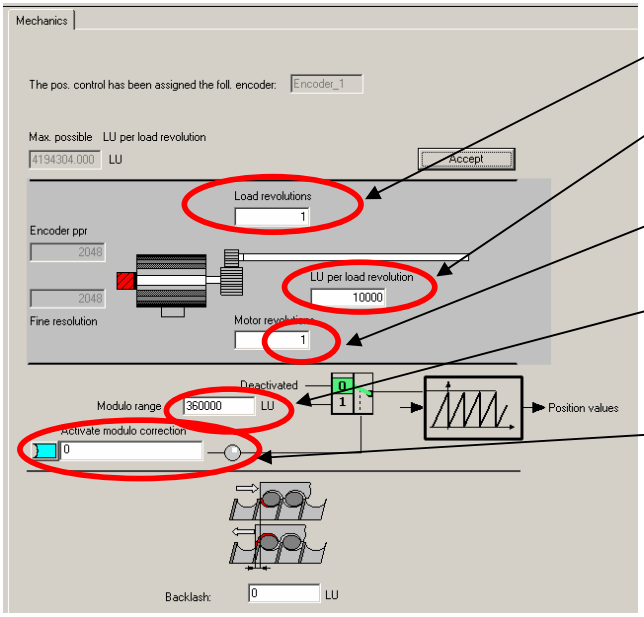
2nd step – define the limits
3rd step – mode: jogging
4th step – mode: homing [referencing]
5th step – mode: traversing blocks
6th step – mode: direct setpoint input/MDI

1st step – configure the mechanical system

8th step - optimization
7th step - monitoring functions

1st step – configuring the mechanical system:

Table 5-2: Configuring the mechanical system



Load revolutions

Gearbox load revolutions

Geared motor revolutions

Modulo length for rotary axes

Activating the modulo correction for rotary axis

Here, enter the ratio between load revolutions and motor revolutions (e.g. gearbox ratio or toothed belt ratio etc.):

Now define your units. Generally for linear axes a normalization 1LU = 1µm is selected. This means that with the following settings for the abbreviation LU you can essentially replace in your mind by the units µm.

A load revolution of 10000 LU is assumed in the factory setting. For instance this could be a spindle with 10 mm (10000 LU) pitch. The value (p2506) is adapted corresponding to the mechanical system being used.

Often 1LU = 1/1000° (1 milli Degree) is defined for rotary axes. This means that the number 360000 is entered in the input field for parameter p2506. For encoders with a low resolution (e.g. resolvers, pulse encoders) and low gearbox ratios, generally the encoder cannot provide the above specified resolution. In this case a lower resolution (e.g. 1LU = 0.1mm) is selected. Any units can be defined for the resolution LU: For example, 1LU = 1/1000 chain link or also 1LU = 1 encoder increment.

For rotary axes activate the axis cycle correction by setting p2577 to 1.

The axis cycle length is entered using p2576. This can, for example, be a mechanical revolution or a product cycle.

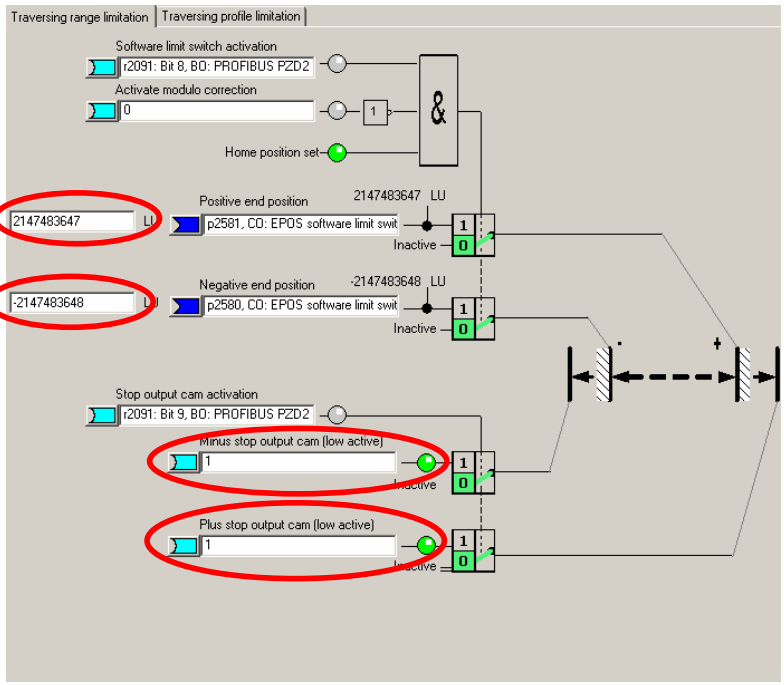
When required backlash compensation can be set using p2583.

2nd step – limits

Here, there are two tabs.

a.) Traversing range limitation

Fig. 5-15: Traversing range limitation



The software limit switches for linear axes (p2577 =0) are set using fixed connectors p2580 and p2581.
Further, stop output cams can be parameterized here (p2569 and p2570); these are generally interlocked using digital inputs.

The drive either responds with a fault or an alarm using a definable stop response (alarm or fault) ("Fault" is preset as response).

The response is set in the Expert list using p2118 and p2119:

Fig. 5-16: Setting in the Expert list

p2118[0]	+	Sets the message number for message type.	7491
p2119[0]	+	Setting the message type	Alarm (A) (2)

The response for the STOP cam in the negative direction is parameterized using number 7491 and for the positive direction using number 7492.

Fault as response:

For a 0 signal at the cam, the drive stops with the OFF3 ramp-down time (p1135), the status signal "Stop cam minus active" or "Stop cam positive active" is set, saved and the corresponding fault is output. After the fault has been acknowledged, only motion away from the STOP cam is permitted. With a 0/1 signal and valid traversing direction exiting the STOP cam is detected and the specified status signals are reset.

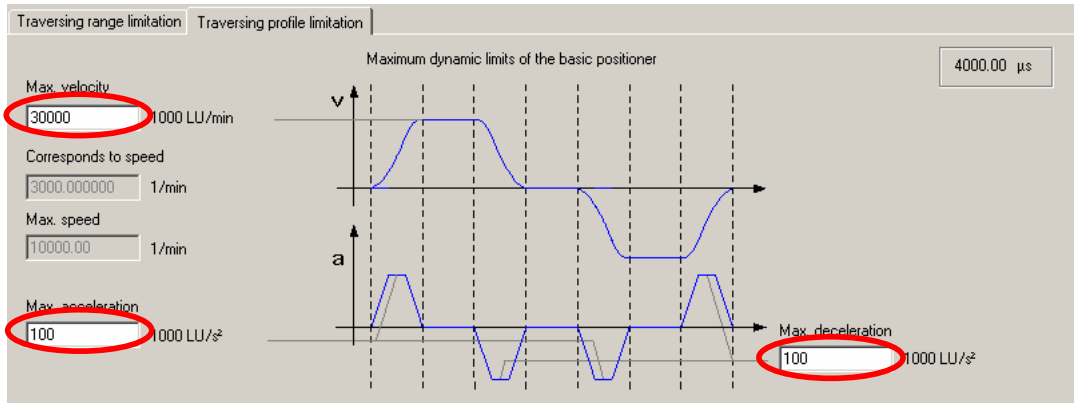
Alarm as response:

For a 0 signal at the cam the drive is stopped with the maximum deceleration (p2573 (refer below), the status signals "Stop cam minus active" or "Stop cam positive active" set, saved and the corresponding alarm is output. Only motion away from the STOP cam is permitted.
For a 0/1 signal and valid traversing direction, exiting the STOP cam is detected and the mentioned status signals are reset

B.) Traversing Profile Limitation

Now go to the next tab - Traversing profile limitation:

Fig. 5-17: Traversing profile limitation



Initially the maximum setpoint velocity p2571 is entered here. Starter calculates the corresponding motor speed. In addition, the maximum speed of the motor being used is specified for information purposes.

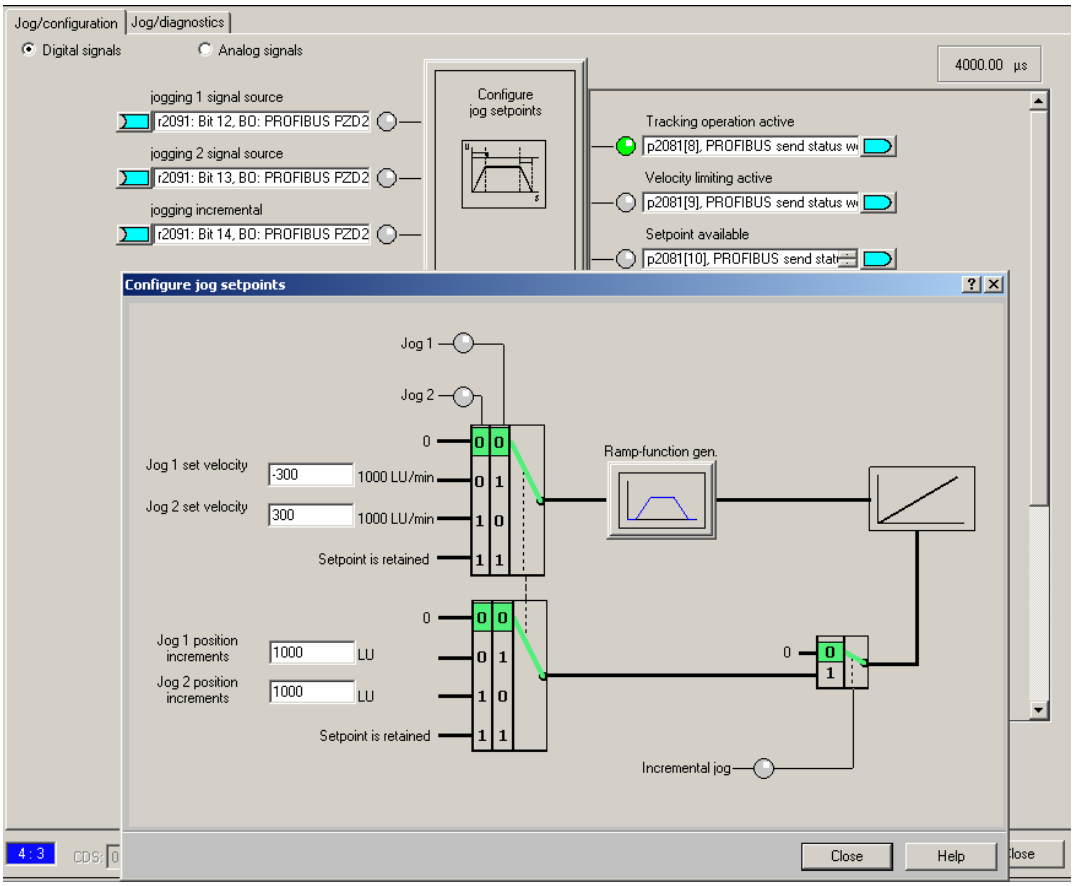
Now define the max. acceleration p2572 and deceleration p2573. The acceleration and deceleration overrides in the modes MDI/direct setpoint input or traversing blocks are referred to these values.

3rd step:

Configure the JOGGING mode (this is only required if you wish to use this mode)

Here, you can specify two different velocity setpoints p2585, p2586 as well as also position setpoints p2587, p2588.

Fig. 5-18: Velocity and position setpoints

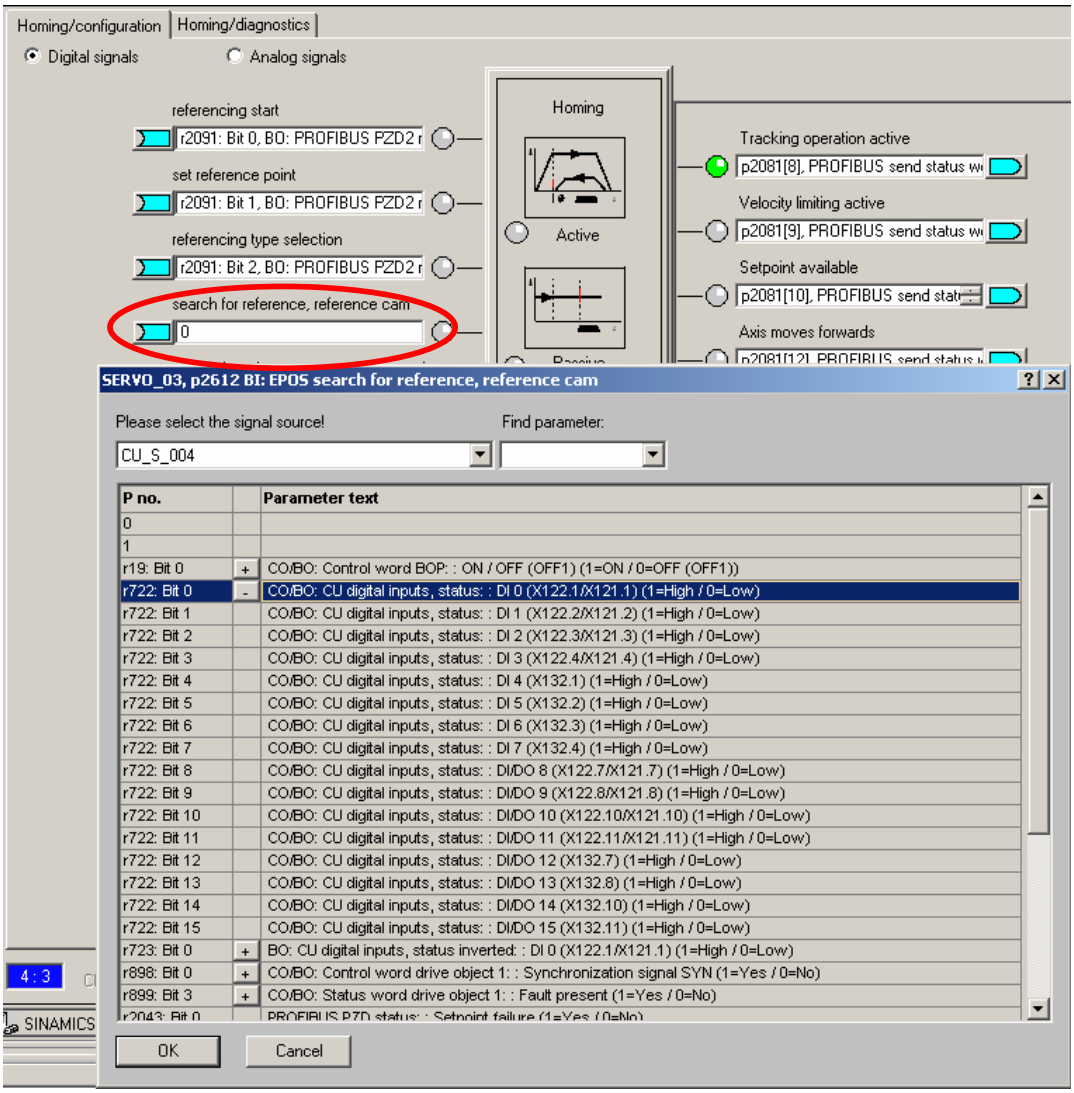


4th step, configuring homing [referencing]

Homing [referencing] (this is only required if the axis is to be homed [referenced] - if, e.g. absolute positioning is used, software limit switches are to be evaluated or traversing blocks configured).

a) Active homing [referencing] of axes with incremental measuring system:

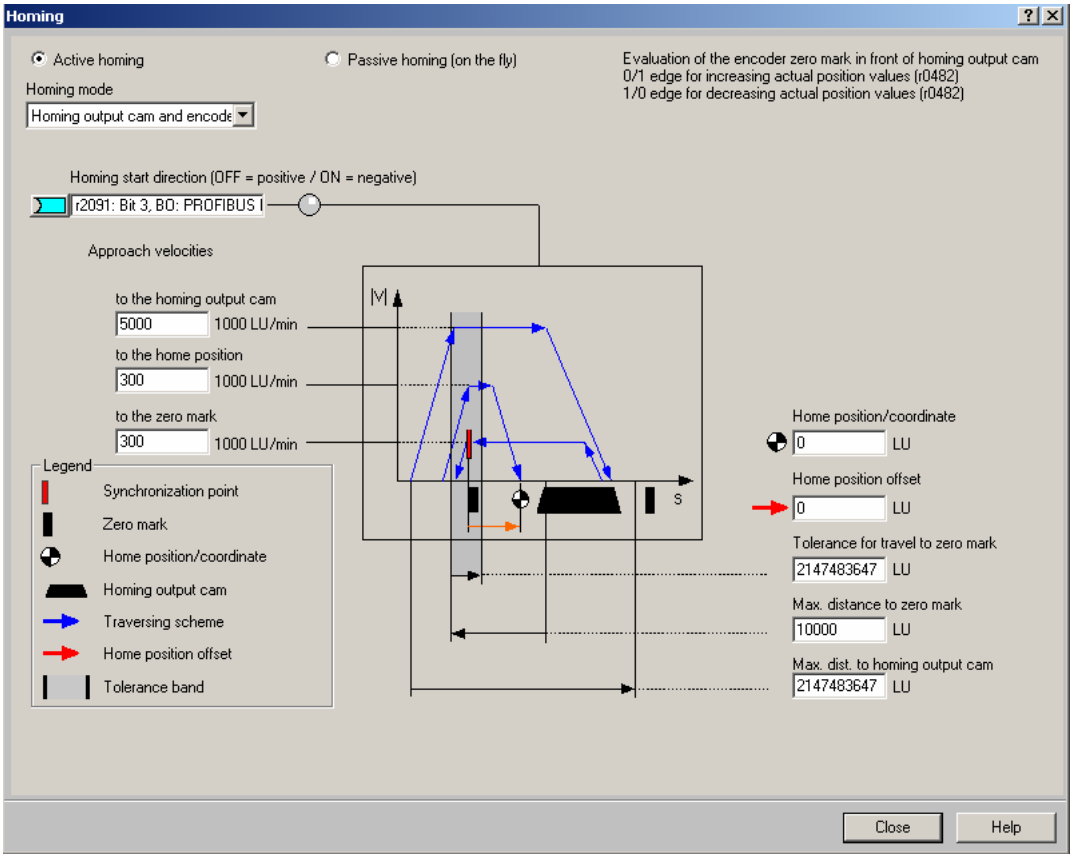
Fig. 5-19: Active axis homing [referencing]



Now define the reference cam, parameter p2612. Proceed in the same way when parameterizing reversing cams that might be used (p2613 and p2614). Please note that reversing cams are only evaluated in the mode "Homing [referencing] position cam and encoder zero mark". For instance, an end cam can be used as a homing [referencing] cam in the mode "External zero mark".

Now open the following screen and define the required homing [referencing] mode:

Fig. 5-20: Defining the homing [referencing] mode

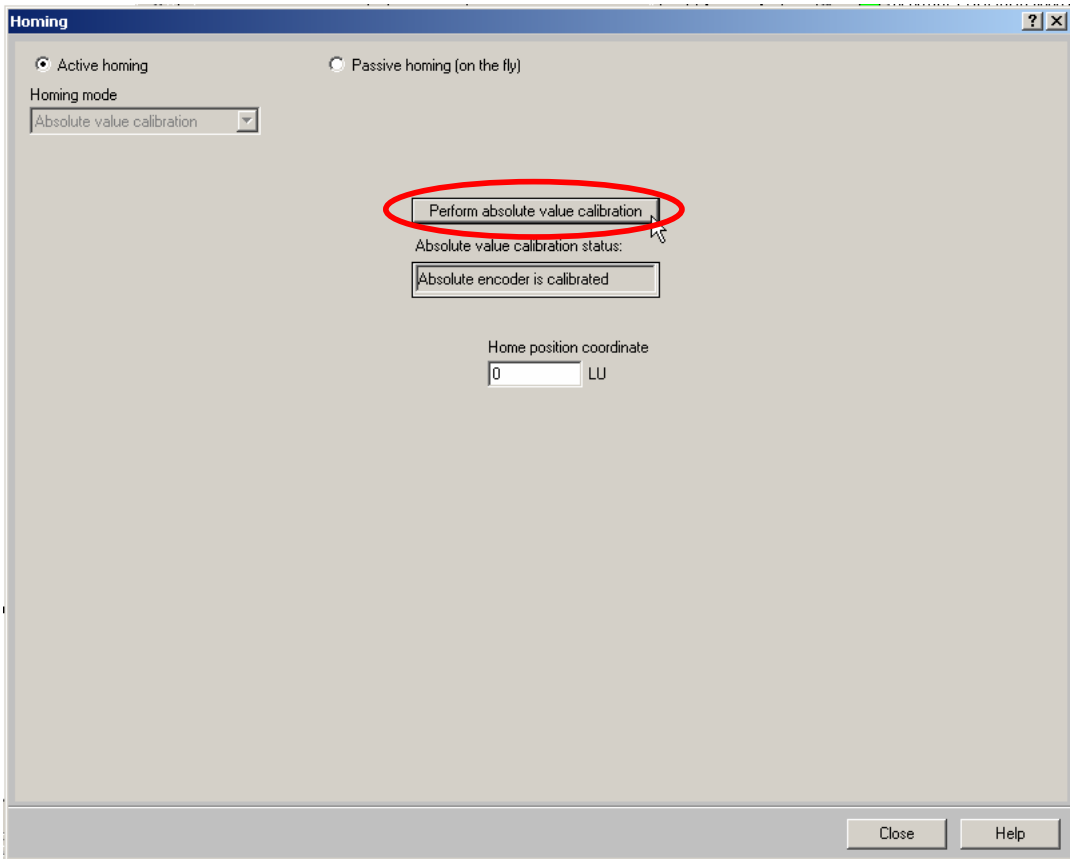


Actively homing [referencing] axes with absolute measuring system

When using an absolute encoder you can calibrate it in the following screen. In this case the drive must be connected ONLINE.

Note The function "Set homing [referencing] position" only functions for absolute encoders while they are still not calibrated.

Fig. 5-21: Calibrating an absolute encoder

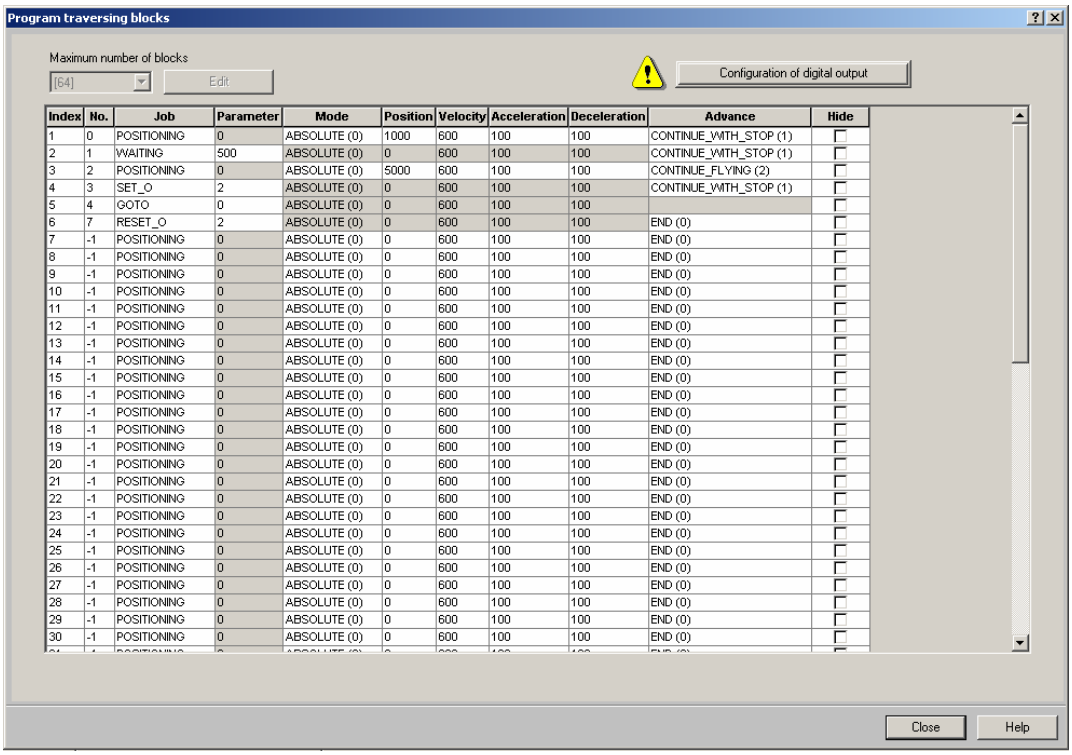


5th step:

Configure the traversing block mode (this is only required if you wish to use this mode)

An example of configuring traversing blocks is shown below:

Fig. 5-22: Configuring traversing blocks



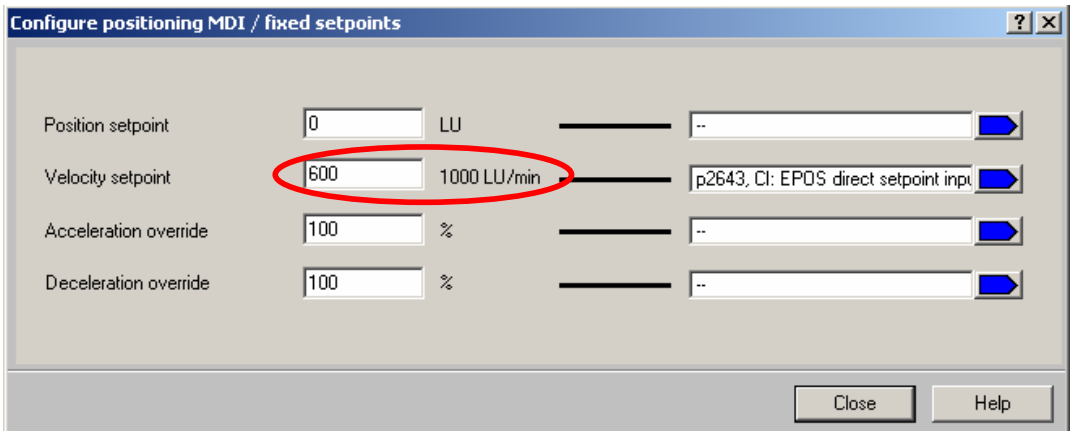
Index	No.	Job	Parameter	Mode	Position	Velocity	Acceleration	Deceleration	Advance	Hide
1	0	POSITIONING	0	ABSOLUTE (0)	1000	600	100	100	CONTINUE_WITH_STOP (1)	
2	1	WAITING	500	ABSOLUTE (0)	0	600	100	100	CONTINUE_WITH_STOP (1)	
3	2	POSITIONING	0	ABSOLUTE (0)	5000	600	100	100	CONTINUE_FLYING (2)	
4	3	SET_O	2	ABSOLUTE (0)	0	600	100	100	CONTINUE_WITH_STOP (1)	
5	4	GOTO	0	ABSOLUTE (0)	0	600	100	100		
6	7	RESET_O	2	ABSOLUTE (0)	0	600	100	100	END (0)	
7	-1	POSITIONING	0	ABSOLUTE (0)	0	600	100	100	END (0)	
8	-1	POSITIONING	0	ABSOLUTE (0)	0	600	100	100	END (0)	
9	-1	POSITIONING	0	ABSOLUTE (0)	0	600	100	100	END (0)	
10	-1	POSITIONING	0	ABSOLUTE (0)	0	600	100	100	END (0)	
11	-1	POSITIONING	0	ABSOLUTE (0)	0	600	100	100	END (0)	
12	-1	POSITIONING	0	ABSOLUTE (0)	0	600	100	100	END (0)	
13	-1	POSITIONING	0	ABSOLUTE (0)	0	600	100	100	END (0)	
14	-1	POSITIONING	0	ABSOLUTE (0)	0	600	100	100	END (0)	
15	-1	POSITIONING	0	ABSOLUTE (0)	0	600	100	100	END (0)	
16	-1	POSITIONING	0	ABSOLUTE (0)	0	600	100	100	END (0)	
17	-1	POSITIONING	0	ABSOLUTE (0)	0	600	100	100	END (0)	
18	-1	POSITIONING	0	ABSOLUTE (0)	0	600	100	100	END (0)	
19	-1	POSITIONING	0	ABSOLUTE (0)	0	600	100	100	END (0)	
20	-1	POSITIONING	0	ABSOLUTE (0)	0	600	100	100	END (0)	
21	-1	POSITIONING	0	ABSOLUTE (0)	0	600	100	100	END (0)	
22	-1	POSITIONING	0	ABSOLUTE (0)	0	600	100	100	END (0)	
23	-1	POSITIONING	0	ABSOLUTE (0)	0	600	100	100	END (0)	
24	-1	POSITIONING	0	ABSOLUTE (0)	0	600	100	100	END (0)	
25	-1	POSITIONING	0	ABSOLUTE (0)	0	600	100	100	END (0)	
26	-1	POSITIONING	0	ABSOLUTE (0)	0	600	100	100	END (0)	
27	-1	POSITIONING	0	ABSOLUTE (0)	0	600	100	100	END (0)	
28	-1	POSITIONING	0	ABSOLUTE (0)	0	600	100	100	END (0)	
29	-1	POSITIONING	0	ABSOLUTE (0)	0	600	100	100	END (0)	
30	-1	POSITIONING	0	ABSOLUTE (0)	0	600	100	100	END (0)	

6th step

Configure the mode MDI/direct setpoint input (this is only required if this mode is to be used).

Parameterize the velocity setpoint that is adapted via the override (from the PLC). The acceleration as well as the deceleration override refer to parameters p2572 and p2573, that are defined in the 2nd step as described above.

Fig. 5-23: Parameterizing the velocity setpoints



7th step: Monitoring functions

The monitoring window and position window can be adapted as shown below.

Note The appropriate position monitoring function can be de-activated by entering a value of 0.

Fig. 5-24: Monitoring and position window 1

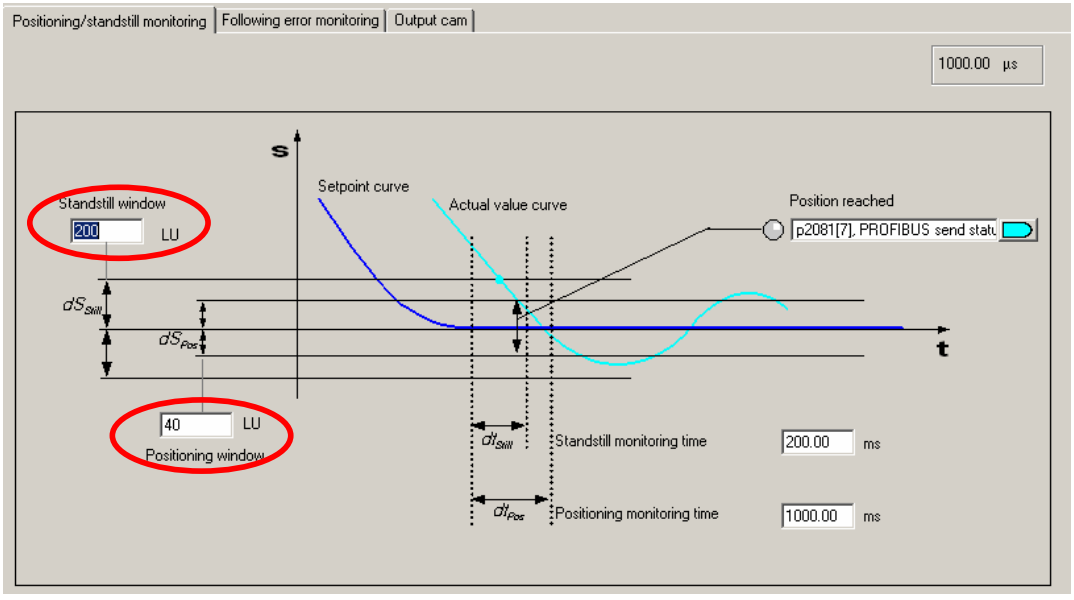


Fig. 5-25: Monitoring and position window 2

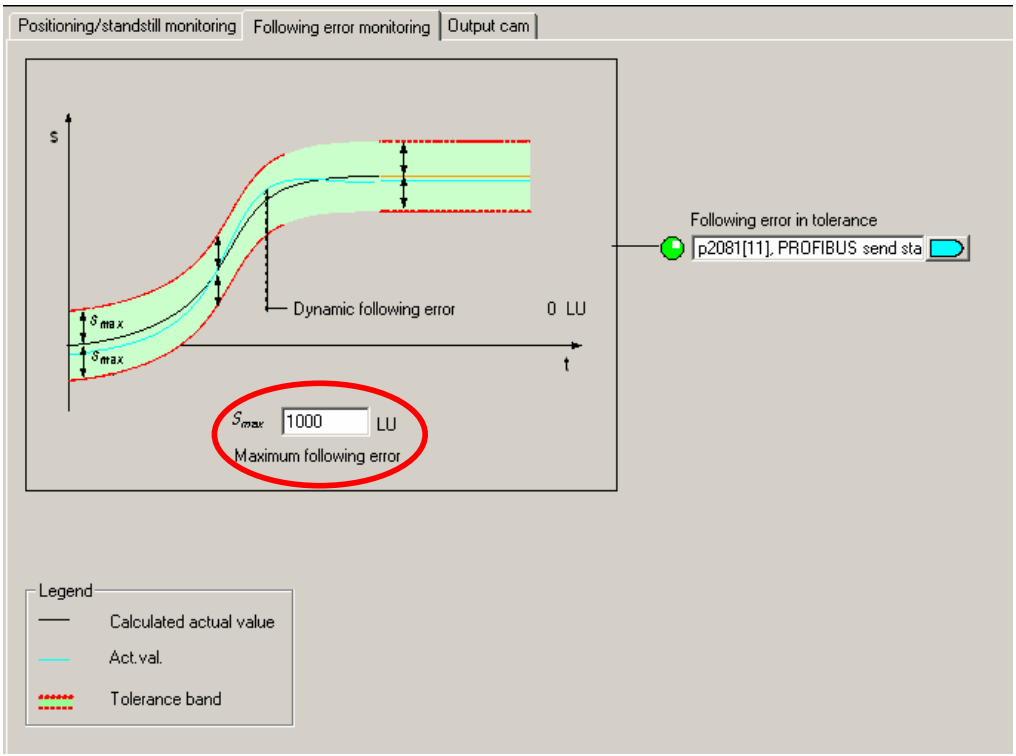
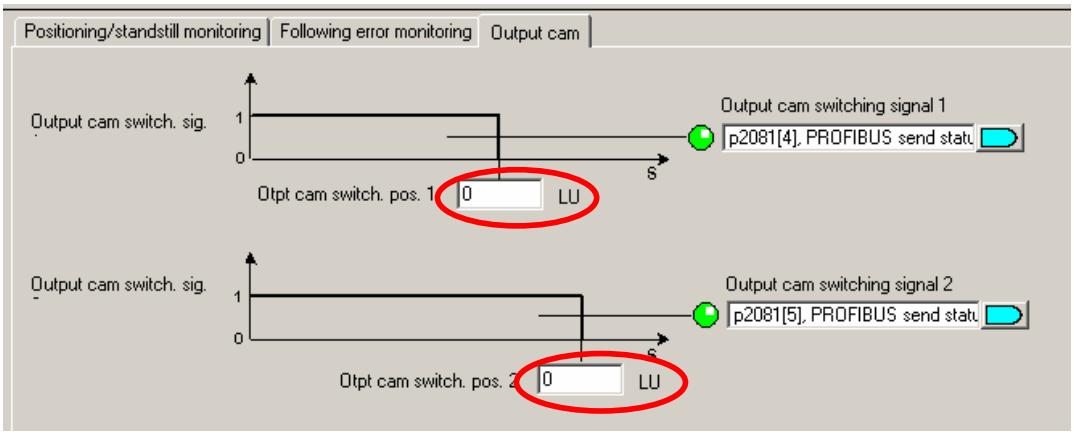


Fig. 5-26: Cam switching signals

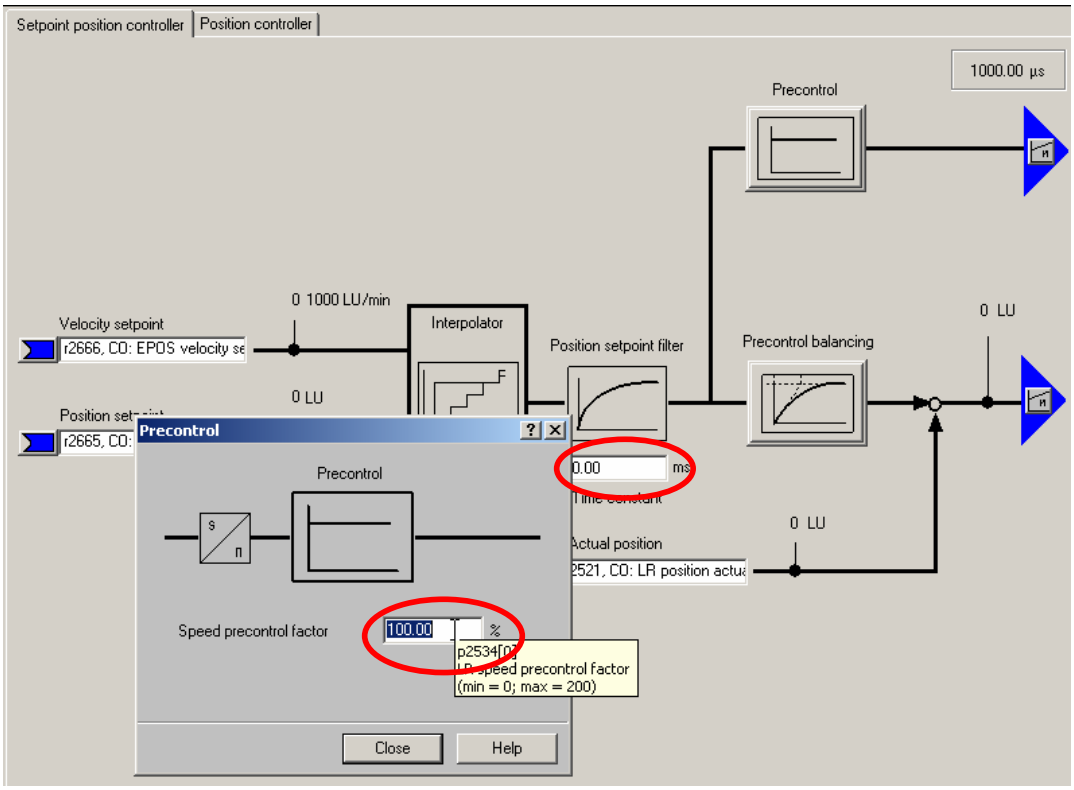


8th step

You can now optimize your control loop.

Please carefully note that with the factory setting, Epos **does not** operate with speed-control. When required this can be activated using p2534, e.g. evaluated with 100%:

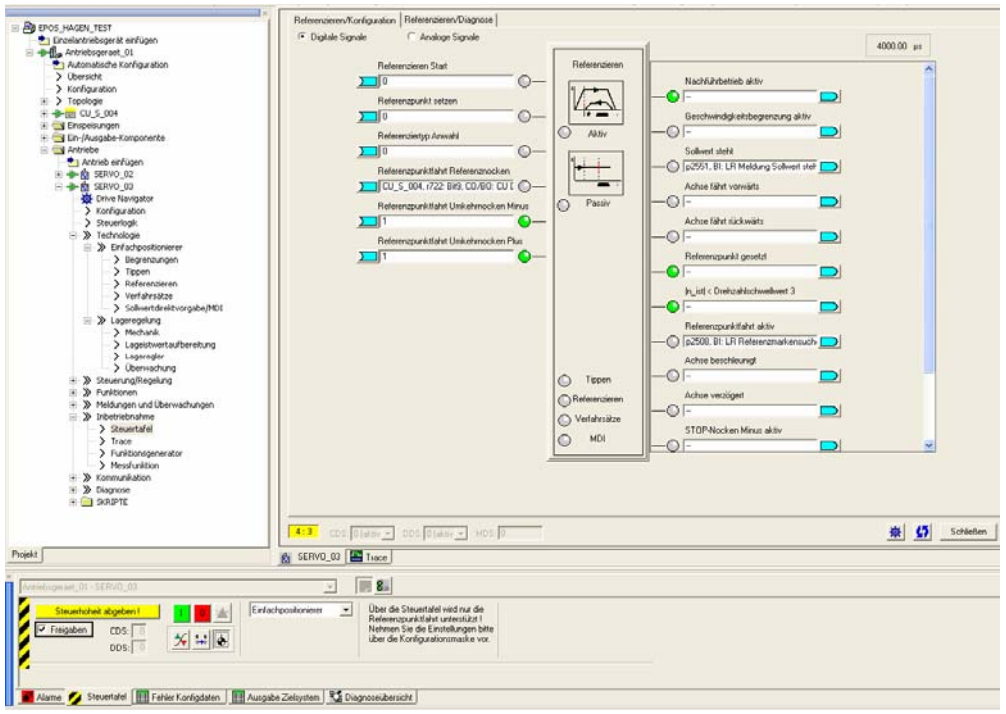
Fig. 5-27: Entering the speed pre-control



It is still possible to select jerk limiting by entering a time constant for the position setpoint filter in p2533.

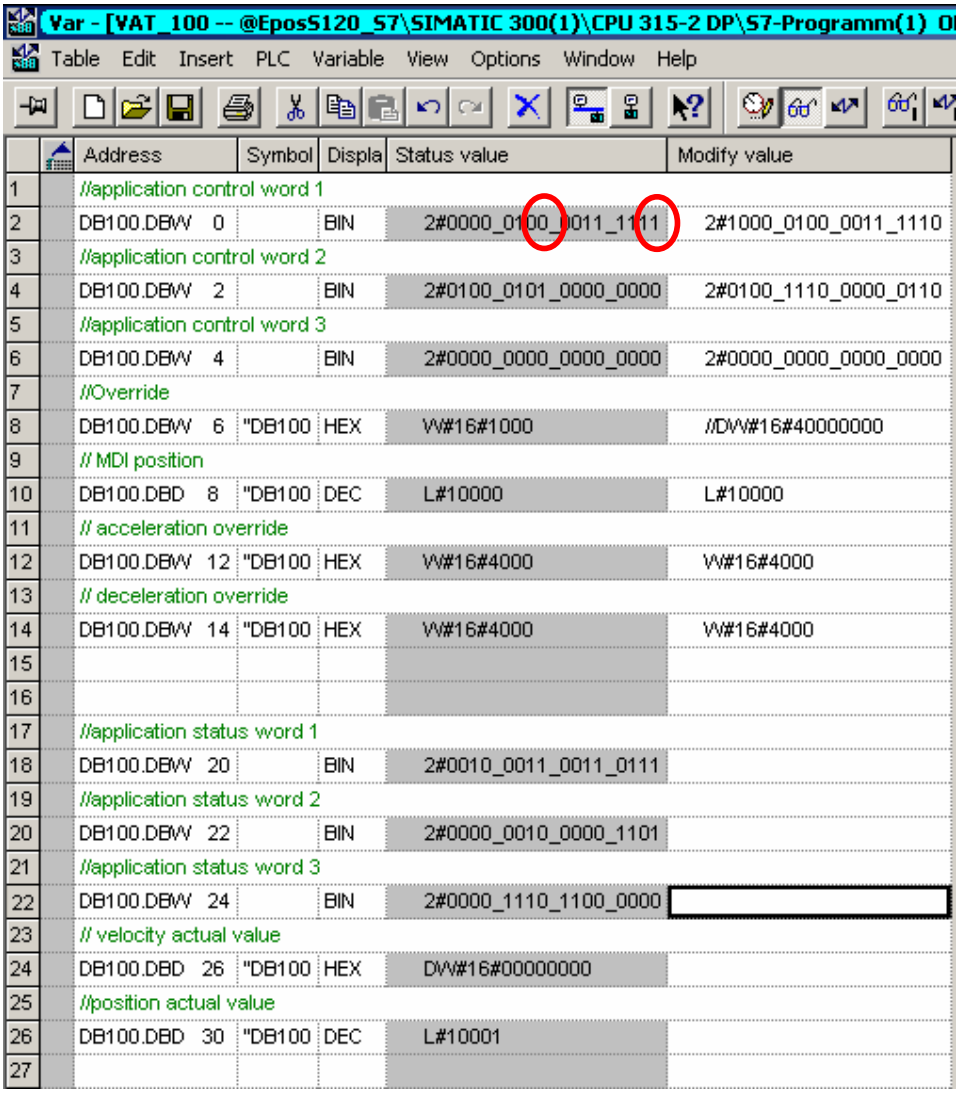
Traversing from a control panel

Table 5-3: Traversing from a control panel

Description	Diagram
Now call the control panel, select the basic positioner and fetch the control authority. After the homing [referencing] mode has been released and selected - a message is displayed that you should enter the settings in the appropriate configuration screen form. Now open the appropriate screen form. You can connect a digital input as reference cam. You can now power-up the drive, traverse the axis and test the various operating modes from the control panel.  Homing [referencing]  Jogging/setting-up  Positioning, relative / absolute	

The drive can now be traversed using the variable table. Control word CTRW1 is already pre-assigned. Now set bit 0 and the drive signals that it is operational. By setting bit 8, e.g. the drive can be moved jogging.

Fig. 5-28: Traversing the drive



	Address	Symbol	Displa	Status value	Modify value
1	//application control word 1				
2	DB100.DBW 0		BIN	2#0000_0100_0011_1111	2#1000_0100_0011_1110
3	//application control word 2				
4	DB100.DBW 2		BIN	2#0100_0101_0000_0000	2#0100_1110_0000_0110
5	//application control word 3				
6	DB100.DBW 4		BIN	2#0000_0000_0000_0000	2#0000_0000_0000_0000
7	//Override				
8	DB100.DBW 6	"DB100	HEX	W#16#1000	//DW#16#40000000
9	// MDI position				
10	DB100.DBD 8	"DB100	DEC	L#10000	L#10000
11	// acceleration override				
12	DB100.DBW 12	"DB100	HEX	W#16#4000	W#16#4000
13	// deceleration override				
14	DB100.DBW 14	"DB100	HEX	W#16#4000	W#16#4000
15					
16					
17	//application status word 1				
18	DB100.DBW 20		BIN	2#0010_0011_0011_0111	
19	//application status word 2				
20	DB100.DBW 22		BIN	2#0000_0010_0000_1101	
21	//application status word 3				
22	DB100.DBW 24		BIN	2#0000_1110_1100_0000	
23	// velocity actual value				
24	DB100.DBD 26	"DB100	HEX	DW#16#00000000	
25	//position actual value				
26	DB100.DBD 30	"DB100	DEC	L#10001	
27					

Attachment

6 General information on the application

6.1 Scope of supply

The "SINAMICS S120 Epos with bus connection" package comprises the following:

S7 project

User-defined value list

Documentation

6.2 Changes/author

Table 6-1: Changes/author

Version	Date/change	Author
V1.0	24.11.2006/ first generated	Stefan Gumbrecht

7 Additional information, tips and tricks, etc.

User-defined lists are available that allow interconnections, pre-assigned using standard telegrams, to be undone.

Visualization interfaces are available for HMI devices - including the fault and alarm numbers of the drive.

8 Literature

Literature

This list is in no way complete and only reflects a selection of suitable literature (references).

Table 8-1

	Title
/1/	SINAMICS List Manual Edition 03/06
/2/	SINAMICS Commissioning Manual Edition 04/06

9 Contact partner

Application Center

SIEMENS

Siemens AG
Automation & Drives
A&D MC PM APC
Frauenauracher Str. 80
Erlangen
Fax: 09131-98-1297
mailto: applications.erlf@siemens.com